APPENDIX A
RECORD OF DECISION
FORMER CHLORINE PLANT (OPERABLE UNIT THREE)
WEYERHAEUSER SITE, PLYMOUTH, NC

PART 1: DECLARATION FOR THE RECORD OF DECISION

A. Site Name and Location

Former Chlorine Plant Area-Operable Unit 3
Weyerhaeuser Company Plymouth Wood Treating Plant Site
Martin County, North Carolina
EPA ID # NCD991278540

B. Statement of Basis and Purpose

This decision document presents the selected remedial action for the Former Chlorine Plant Area of the Weyerhaeuser Company Plymouth Wood Treating Plant Site, Martin County, North Carolina, chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the administrative record file for this Site.

The State of North Carolina concurs with the selected remedy.

C. Assessment of the Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

D. Description of the Selected Remedy

The Weyerhaeuser Company Wood Treating Plant Site is comprised of 4 areas of concern which are being investigated separately in focused Remedial Investigations and Feasibility Studies. The 4 areas are Landfill No. 1, the Former Chlorine Plant, Welch Creek and the Roanoke River.

This remedy addresses the threat posed by the Former Chlorine Plant Area of the Weyerhaeuser Site. Mercury contamination in soil in the immediate area of the Former Chlorine Plant is the major threat to human health and the environment. The major components of the selected remedy include:

- A Barrier Wall Containment system for contaminated soils largely within the footprint of the Former Chlorine Plant building;
- Shallow Target Area Excavations of contaminated soils;
- A Surface Cap Containment system;
- Groundwater monitoring; and

- Institutional Controls for land and groundwater use.

E. Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective.

The remedy for the Former Chlorine Plant Area does not satisfy the statutory preference for treatment as a principal element because the remedy for the Site is containment. However, the excavation of the Target Areas soils may result in treatment if contaminant levels exceed a threshold level.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

F. ROD Data Certification

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations.
- Baseline risk represented by the chemicals of concern.
- Cleanup levels established for chemicals of concern and the basis for these levels.
- Description of the Principal Threat waste at the site.
- Current and reasonably anticipated future land use assumptions and current and potential beneficial uses of ground water used in the baseline risk assessment and FS.
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy.
- Established capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factors that led to selecting the remedy.

G. Authorizing S ure

9-29-03

Winston Smith, Direct
Waste Management D n

Date

PART 2: THE DECISION SUMMARY

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Appendixes

A. Site Name, Location and Description

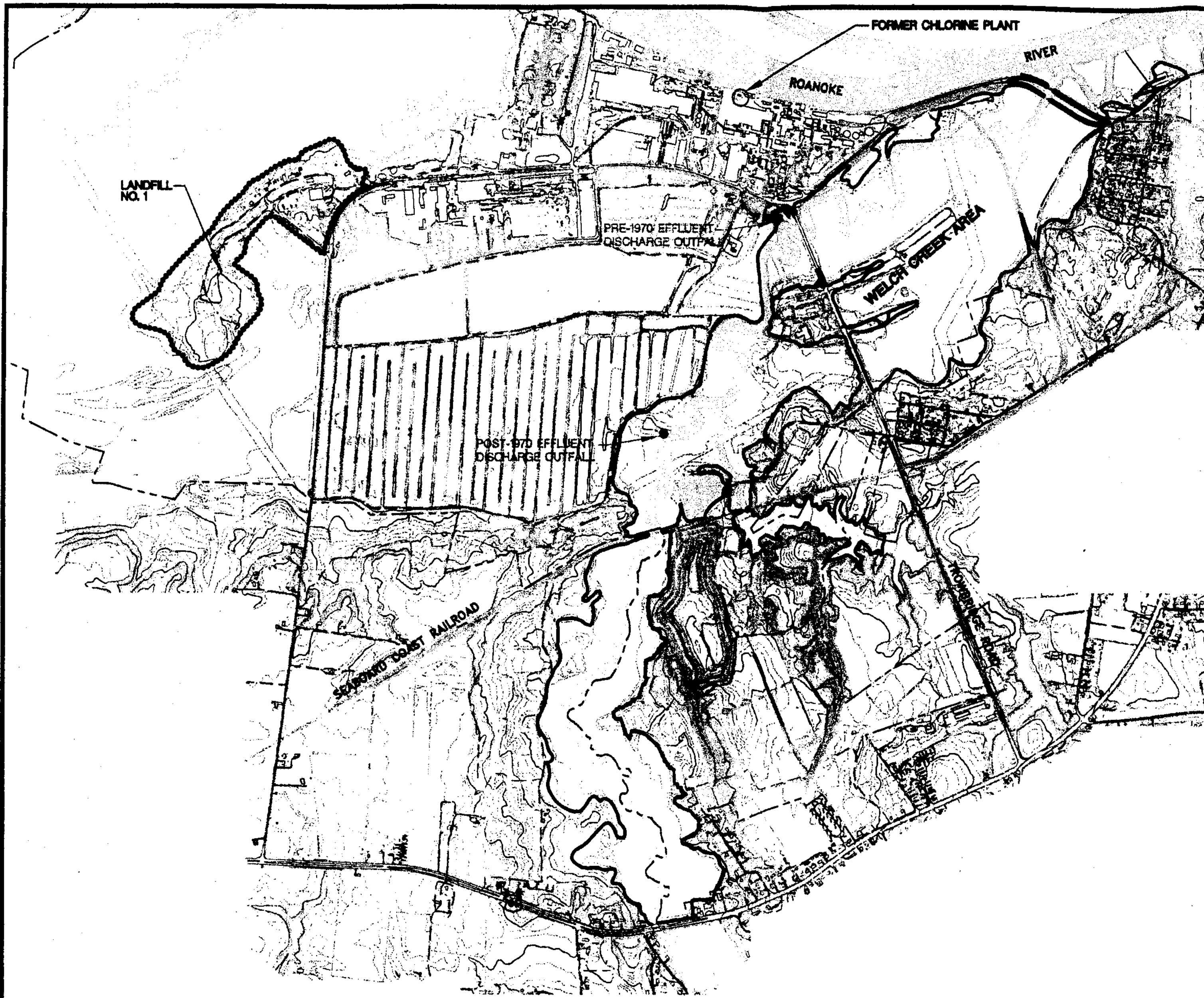
The Weyerhaeuser Company Wood Treating Plant Site is an active wood and paper products manufacturing facility located just outside of the city limits of Plymouth, Martin County, North Carolina. The CERCLIS Site ID number is NCD991278540. The EPA has the enforcement lead at the Site, with support from the North Carolina Department of Environment and Natural Resources (NCDENR). EPA plans to negotiate a Consent Decree with the Responsible Party to conduct and pay for the cleanup at the Site.

Current operations at the Site include the production of fluff paper, paper, paperboard and finished lumber. Weyerhaeuser has been the owner/operator of this facility since 1957, after merging with the Kieckhefer-Eddy Corporation, which began operation at the site in 1937. The facility is located on approximately 2,400 acres, about 1.5 miles west of the town of Plymouth. The Former Chlorine Plant Area is approximately 3 acres in size, located adjacent to the Roanoke River in an active manufacturing area of the facility. A steel sheet-piling seawall (bulkhead) forms the entire northern boundary with the River in this part of the facility. The area is primarily covered with asphalt and concrete pavement. **Figure A-1** shows the approximate location of the Former Chlorine Plant Area at the facility, and the size of the study area.

B. Site History and Enforcement Activities

The Former Chlorine Plant was built in 1951 and operated until 1968. Operations involved the production of chlorine and sodium hydroxide from salt brine. Twelve mercury cells, containing metallic mercury, were used in the production process. Process equipment was removed from the Former Chlorine Plant building from 1968-1978. The building was then used for storage and equipment maintenance until 1984. The building was demolished in 1986 and 1987. In 1992, the building slab, footings, a U-shaped concrete drain (the Central U-drain), tank foundations and surrounding soil down to the water table (to approximately 4 feet) were removed. The excavation was backfilled with soil and concrete and paved with asphalt. Soil samples were collected from the base of the excavation at the completion of the soil removal. Mercury concentrations in the soil not excavated were as high as 9,520 mg/kg. An additional U-shaped drain (the Eastern U-drain) was identified during the Remedial Investigation planning.

A Special Notice Letter was sent to Weyerhaeuser Company by the EPA on November 19, 1997, notifying them of potential liability, as defined by Section 107 (a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, that Weyerhaeuser may have incurred with respect to the Site. The Special Notice Letter outlined four areas on, and adjacent to, the facility property which, following initial investigation by EPA and the NCDENR, were documented to have caused a release or the threat of a release of hazardous substances, pollutants or contaminants. The four areas are: 1) The Landfill No. 1 Area; 2) The Former Chlorine Plant Area; 3) Welch Creek; and 4) The Roanoke River. After successful negotiations between EPA and Weyerhaeuser, an Administrative Order



STATE LOCATION

SOURCE:

BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC., CHARLOTTE, NORTH CAROLINA. DATE OF PHOTOGRAPHY: DECEMBER 20, 1994.

APPROXIMATE LIMIT OF THE 10-YEAR FLOOD PLAIN

APPROXIMATE PROPERTY LINE

0 1500' 3000'

SCALE: 1"=1500'

WEYERHAEUSER CO.
FORMER CHLORINE PLANT
SITE LOCATOR MAP
FINAL REMEDIAL INVESTIGATION
MARTIN COUNTY, NORTH CAROLINA

RMT

DWN. BY:	STORMERL
APPROVED BY:	JMR
DATE:	JUNE 2000
PROJ. #	5100.23

Figure A-1

by Consent (AOC) was signed by both parties on March 24, 1998. The Remedial Investigation/Feasibility Study for the Landfill No. 1 Area, The Former Chlorine Plant Area and Welch Creek were covered under the terms of the AOC and the attached Statement of Work (SOW). The Roanoke River is being investigated as a separate Operable Unit by the EPA using Superfund funding. A ROD was issued for the Landfill No. 1 Area on September 19, 2002. On August 18, 2003 EPA and Weyerhaeuser entered into a Consent Decree for the RD/RA for the Landfill No. 1 Area.

C. Community Participation

Pursuant to CERCLA Sections 113(k)(2)(B)(i-v) and 117, the RI/FS Report and the Proposed Plan for the Site were released to the public for comment on June 30, 2003. These documents were made available to the public in the administrative record located in an information repository maintained at the EPA Docket Room in Region IV and at the Washington County Public Library in Plymouth, North Carolina.

The notice of the availability of these documents was published in the Roanoke Beacon, Plymouth North Carolina, on July 2, 2003 A pubic comment period on the documents was held from July 2, 2003 to August 1, 2003. A copy of the notice and the Proposed Plan Fact sheet were mailed to the Site mailing list which contains names of community members and interested parties. In addition, a public meeting was held on July 10, 2003. At this meeting, representatives from EPA answered questions about the Site and the remedial alternatives under consideration. Meetings with city and county officials were also held.

Other community relations activities included:

- Development of a community relations plan.
- An RI kick-off public meeting held in the community on March 23, 1999.
- Issuance of a fact sheet on the RI/FS process and progress in March, 1999 and January, 2001.
- Issuance of a fact sheet on the Proposed Plan for the Landfill No. 1 Area in March, 2002, followed by a Public Meeting in April, 2002.
- Issuance of a fact sheet on the Proposed Plan for the Former Chlorine Plant Area in July, 2003, followed by a Public meeting in July, 2003.
- Informed citizens of the Technical Assistance Grant and Community Advisory Group program (literature placed in repository).

D. Scope and Role of Operable Unit within Site Strategy

Because of the geographic separation of the three areas, and the differences in the type of contamination present and the media impacted, individual RI/FS work and reports have been prepared for each of the three areas identified in the AOC. These focused investigations were conducted in order to streamline the investigation and remedy selection process. EPA plans to issue a ROD for each of the three areas of the site. The Roanoke River is being investigated by EPA using Superfund funding, and is designated as Operable Unit 2. The Operable Unit designations given to each area are:

Operable Unit 1: Landfill No. 1 Area;
Operable Unit 2: Roanoke River
Operable Unit 3: The Former Chlorine Plant; and
Operable Unit 4: Welch Creek.

E. Site Characteristics

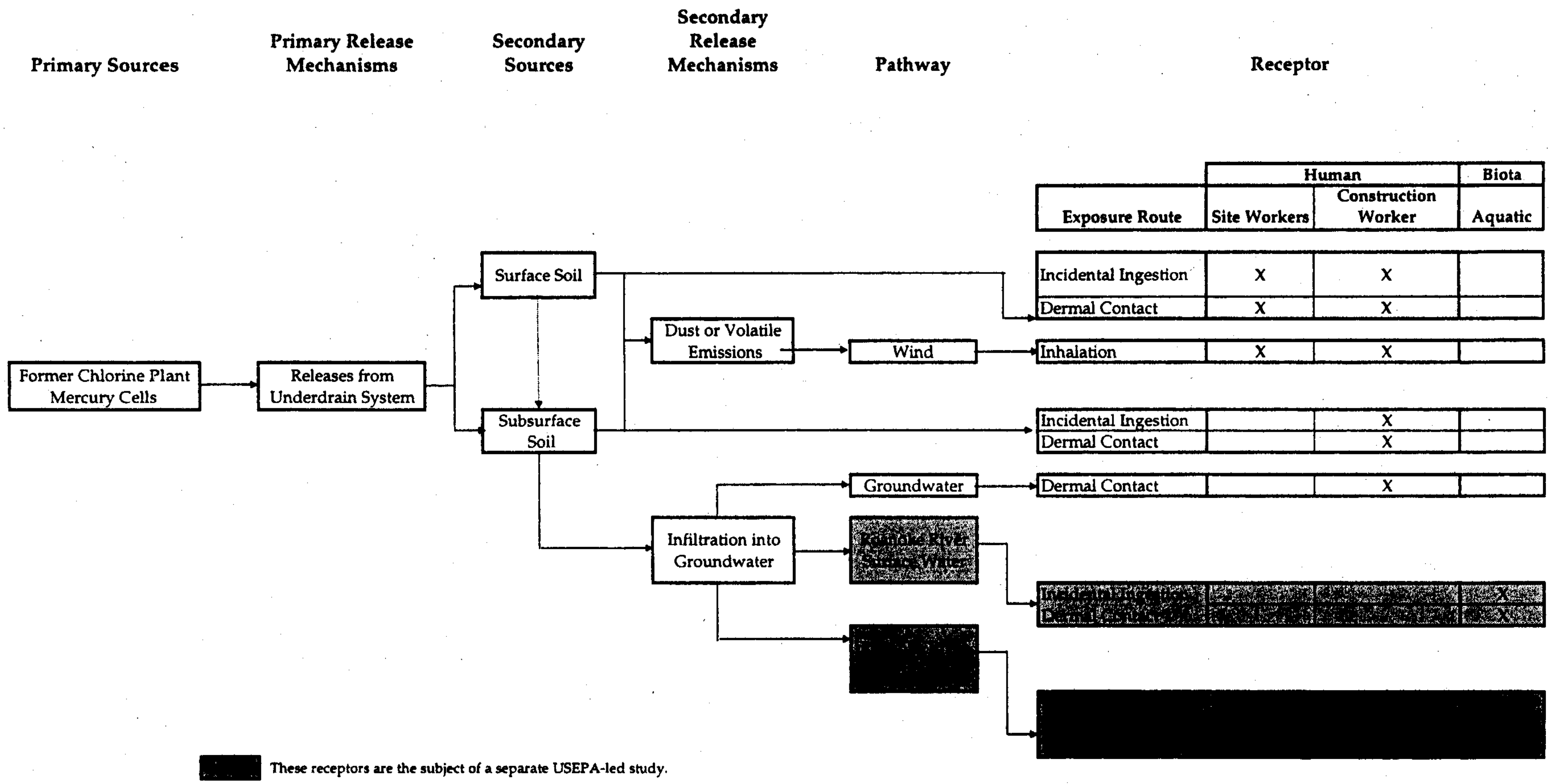
1. Conceptual Site Model

The Remedial Investigation for the Former Chlorine Plant Area began with the development of an RI Work Plan, and a Conceptual Site Model. The Conceptual Site Model formed the basis for the investigation and risk assessment for the Former Chlorine Plant Area. The Conceptual Site Model for the Former Chlorine Plant Area is based on characteristics of the waste sources, the contaminants of potential concern (COPCs) for each affected environmental medium, and the migration and transport potential of the constituents to potential receptors. The primary original source of releases were the Former Chlorine Plant mercury cells and underdrain system. Surface and subsurface soil contamination is transported through precipitation to groundwater, and through volatilization and dust to the atmosphere. Groundwater contaminated with mercury eventually discharges downgradient to the Roanoke River immediately adjacent to the Former Chlorine Plant. The Conceptual Site Model for the Former Chlorine Plant Area is shown in **Figure E-1.**

2. Site Setting

The Weyerhaeuser facility is located in a low-lying area near the confluence of Welch Creek and the Roanoke River. In general, the area comprises flat, low-lying terrain typical of the Tidewater region within the Coastal Plain Physiographic Province of North Carolina. At portions of the facility east of Welch Creek, ground surface elevations rise to 30 to 40 feet above mean sea level. The Former Chlorine Plant Area is at an elevation of approximately 8 feet, generally within the 5-foot to 15-foot elevation range typical for the region.

Figure E-1
Preliminary Conceptual Model for Former Chlorine Plant



The Former Chlorine Plant Area is currently used for the loading, unloading, and storage of raw materials used at the facility. This results in significant fork lift and semi-truck traffic. Other structures in the area include storage sheds, a raw materials storage pad (drums) in the Former Chlorine Plant building footprint, a bank of the facility's cooling towers to the north adjacent to the River, and the former polycoater building to the west (now used for paper roll storage).

3. Regional Geology and Hydrogeology

The geology in the region generally consists of a wedge of clastic sediment and marine limestone that thickens from west to east. The sediment consists of sand, silt, and clay. The sand is deposited in poorly connected bodies that may have only a limited horizontal and vertical extent. However, on a regional scale, differences in the frequency of occurrence and the interconnection of the sand bodies are sufficient enough to distinguish regional aquifers from regional aquitards.

The shallowest unit is the Quaternary-age surficial aquifer. It consists of fine sand, silt, clay, and peat that form a unit of less than 50 feet in thickness. Sand typically makes up greater than 70 percent of the unit in the Plymouth, North Carolina, area.

Beneath the surficial aquifer is the Yorktown confining unit. These Pliocene-age marine deposits typically consist of up to 50 feet of clay and sandy clay, with occasional beds of fine sand or shells. In the Plymouth, North Carolina Area, the confining unit is reported to be about 40 feet thick.

The Yorktown aquifer is immediately beneath the confining clay. It consists of fine sand, silty and clayey sand, and clay with shells and shell beds throughout the aquifer. From 70 to 80 percent of the aquifer is sand in the Plymouth, North Carolina, area.

The confining unit of the Pungo River Formation is composed of Miocene-age clay from the lowermost Yorktown Formation and the top of the Pungo River Formation. The unit is typically more than 90 percent clay and averages 55 feet in thickness. The Pungo River aquifer below the clay is only about 10 feet thick near Plymouth, North Carolina.

The Pungo River aquifer is separated from the Eocene-age Castle Hayne aquifer by the thin, and in some areas discontinuous, Castle Hayne confining unit. Where present, the Castle Hayne confining unit consists of clay and sandy clay.

The Castle Hayne aquifer is composed predominantly of loose consolidated to hard (recrystallized) limestone, fine to coarse carbonate sand, and marl (clayey limestone). Limestone dominates the lithology in the top third to the top half of the aquifer, while sand dominates in the lower aquifer. The elevation of the aquifer below Plymouth, North Carolina, is reported to be about -130 feet. This is the most productive aquifer in North Carolina, with an average hydraulic conductivity of 6.5×10^{-4} ft/s.

At least five other confining/aquifer units have been identified below Plymouth, North Carolina. The deeper units are of little relevance because the Castle Hayne aquifer is the regional water supply aquifer below the Site.

4. Area Ground Water Use

The majority of the Weyerhaeuser facility process water is obtained from the Roanoke River. Historical records indicate that as many as 30 water supply wells have been drilled on the Weyerhaeuser facility since 1937. Of the 19 wells not currently in use, construction documentation for five indicates that well intakes were between 113 to 160 feet in depth. These depths indicate that the Castle Hayne aquifer was the source of water for the wells. All nineteen wells were properly abandoned. Water supply wells currently in use obtain their water from the Castle Hayne aquifer.

There are no private water supply wells within 1 mile of the Former Chlorine Plant. It is estimated that about 330 people may be served by private wells within the three mile radius of the facility and south of the Roanoke River. Approximately 2.7 square miles of the area within the three mile radius are served by public water service from the City of Plymouth, and 4.3 square miles are part of the Weyerhaeuser facility. Private wells typically draw water from depths of 100 to 200 feet, within the Castle Hayne aquifer.

The nearest private well is about 1.1 miles to the south of the Former Chlorine Plant. This well is reportedly 160 feet deep and is likely completed in the Castle Hayne aquifer. Regional ground water flow in the aquifer is from west to east, therefore, the nearest well to the Former Chlorine Plant is not downgradient of the plant. There is a cluster of homes to the southeast that is just over a mile from the facility. This area and the remaining residential areas are also not downgradient from the site.

The City of Plymouth operates four public water supply wells just outside the 3-mile radius of the facility. The water supply system services approximately 5,900 people. The city system includes four wells located to the east of the plant site. The wells are from 115 to 185 feet deep, within the Castle Hayne (and possibly Pungo River) aquifers. Regionally, the general horizontal direction of groundwater flow within these formations is west to east, placing the City wells not downgradient of the landfill.

5. Remedial Investigation Field Work

The RI field work at the Former Chlorine Plant Area was completed during two mobilizations, conducted from February to May of 1999.

Samples were assigned a unique alpha-numeric sample descriptor identifying the study area; media types; sample number; and, in certain instances, sample depth. The relevant study area descriptors for the Former Chlorine Plant Area are as follows:

- CP=Former Chlorine Plant
- PW=Pore Water
- SD=Sediment
- SS=Surface Soil
- SB=Subsurface Soil
- PZ=Piezometer

The sampling locations for the RI are shown on **Figure E-2.**

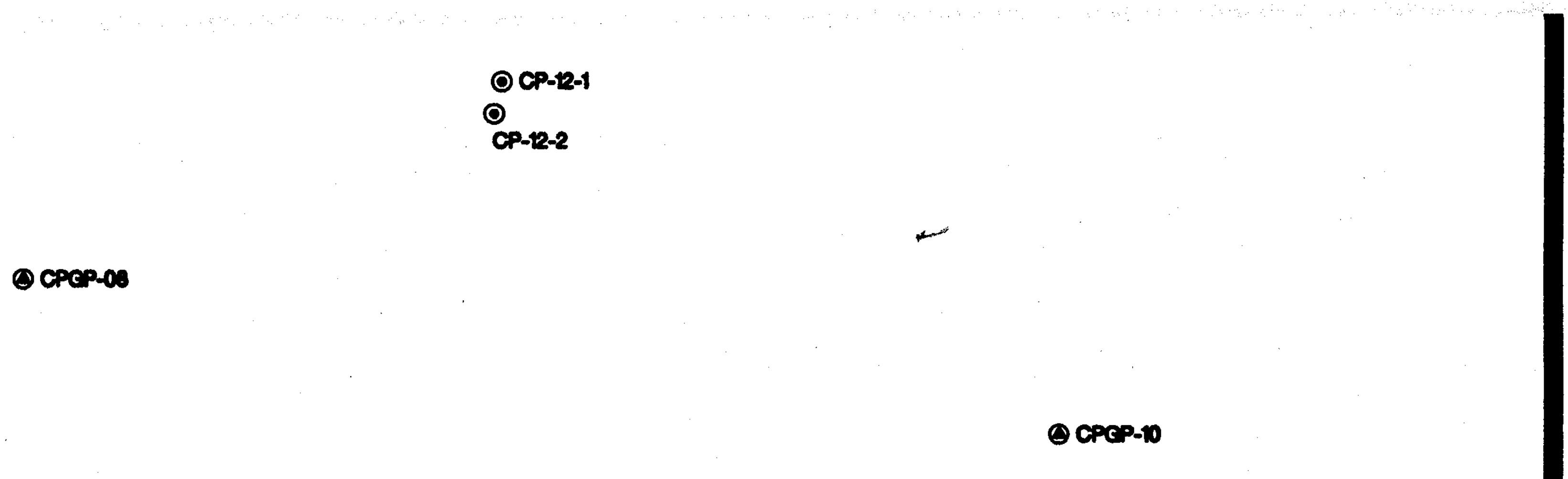
Remedial Investigation site characterization activities included soil, groundwater and near -shore sediment sampling. Specifically, the sampling efforts included the collection of 3 surface soil samples, the advancement of 23 soil borings to various depths, the installation of 32 on-shore monitoring wells and 11 temporary mini-piezometers in the river along the bulkhead, the advancement of 18 sediment thickness probes, and the collection of 10 sediment core samples and three pore water samples. Samples were analyzed primarily for mercury. Additional analyses were conducted to quantify the presence of methyl mercury and bioassay indicators, to assess leachability, and to define inorganic constituents that may impact mercury treatment. This information in conjunction with historical data was used to evaluate the nature and extent of the constituents of concern.

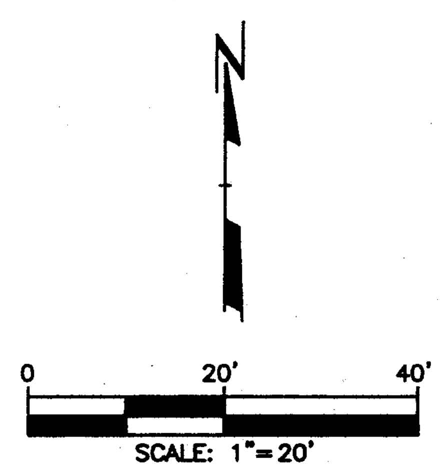
6. Contaminant Distribution

a. Soil

Surface soil (to depths of 2 feet) was sampled in the limited unpaved area along the bulkhead. Total mercury was detected in only one of the three surface samples, at a total mercury concentration of 7.3 mg/kg.

The highest concentrations of mercury in the subsurface soil below the pavement were coincident with the former building footprint and associated U-drains. Total mercury concentrations ranged from <0.04 to 45,800 mg/kg. Flecks and beads of metallic mercury were observed in soil samples from directly below the building footprint to a depth of 42 feet below ground surface, and are likely present as a result of leaks from the historical building drains.





PROJECT: **WEYERHAEUSER CO.**
FINAL REMEDIAL INVESTIGATION
MARTIN COUNTY, NORTH CAROLINA

SHEET TITLE:
FORMER CHLORINE PLANT SAMPLING LOCATIONS

DRAWN BY: STORMERL	SCALE:	PROJ. NO. 5100.23
CHECKED BY: JMR	1"=20'	FILE NO. 51002328.DWG
APPROVED BY: KDK	DATE PRINTED: JUN 30 2000	**FIGURE E-1**
DATE: JUNE 2000		

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608/831-4444

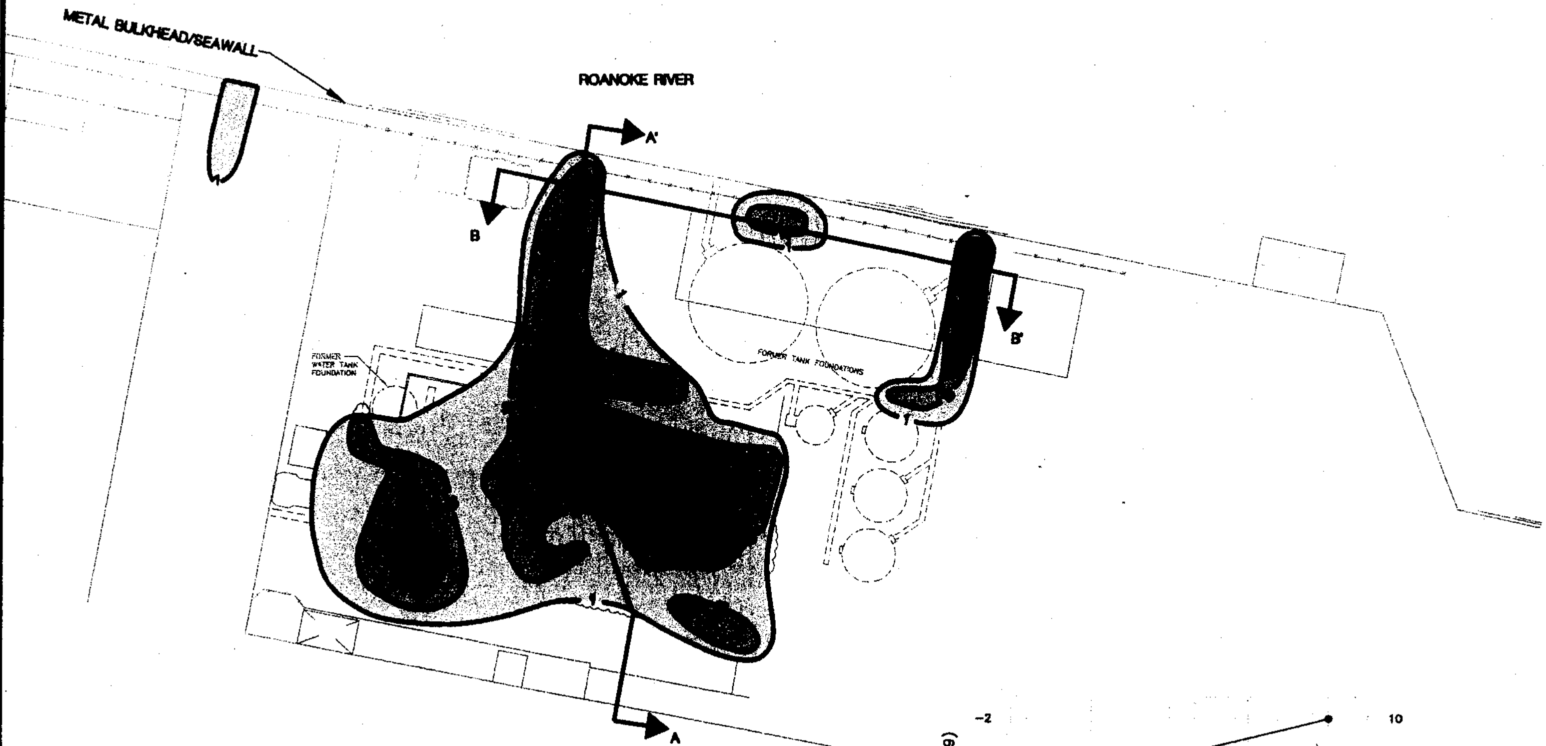
OVERSIZED FIGURE
SEE FIGURE 3-1 OF FINAL RI REPORT

However, no contiguous separate phase of metallic mercury was observed during the RI.

Soil volumes were determined for various concentration limits as indicated in the following table:

Total Mercury Concentration (mg/kg)	Mass of Mercury (lbs)	Volume of Mercury Containing Soil (cubic yards)
>1	7,500	9,300
>10	7,500	4,800
>100	7,200	1,700
>1,000	6,200	580

The occurrence and concentration of mercury in soil decreases with depth and distance from the Former Chlorine Plant footprint. Additionally, most of the concentrations greater than 100 mg/kg are within the building footprint, typically below the former mercury cell sumps and associated U-drains. The RI concluded that approximately 95 percent of the mercury mass is associated with concentrations above 100 mg/kg, and approximately 98 percent of the mercury containing soil is located above 26 feet below ground surface. Methyl mercury represents less than 1 percent of the total mercury in the subsurface soil tested. **Figure E-3** presents a summary of the maximum subsurface soil mercury concentrations detected during the RI, and **Figure E-4** illustrates the extent of total mercury in subsurface soil in cross-sectional view. **Tables E-1 and E-2** present the results of surface soil and subsurface soil sampling conducted during the RI.



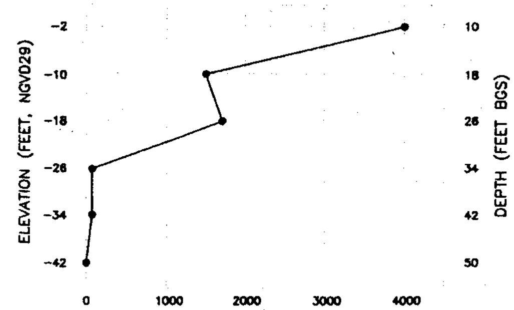
LEGEND

TOTAL MERCURY CONCENTRATION IN SOIL AREAL EXTENT

- 1 TO 10 mg/kg
- 10 TO 100 mg/kg
- > 100 mg/kg

NOTES

1. GROUND SURFACE ELEVATION APPROXIMATELY 8FT. (NGVD29).
2. VERTICAL DISTRIBUTION PROFILE BASED ON 1 mg/kg CONCENTRATION CONTOUR.
3. CROSS SECTION LOCATIONS ARE APPROXIMATE.



ESTIMATED MASS OF MERCURY (POUNDS) AT EACH INTERVAL[1]

(1) CUMULATIVE MASS= 7,500 LBS.

0 50' 100'

SCALE: 1"=50'

PROJECT: FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA		
SHEET TITLE: TOTAL MERCURY IN SUBSURFACE SOIL AT FORMER CHLORINE PLANT PLAN VIEW		
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 05100.83
CHECKED BY: JMR	1"= 50'	FILE NO. 51006313.DWG
APPROVED BY: BSS	DATE PRINTED:	
DATE: JUNE 2003	JUN 24 2003	Figure E-3

RMT INC.

11

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Attached Image's: No images attached

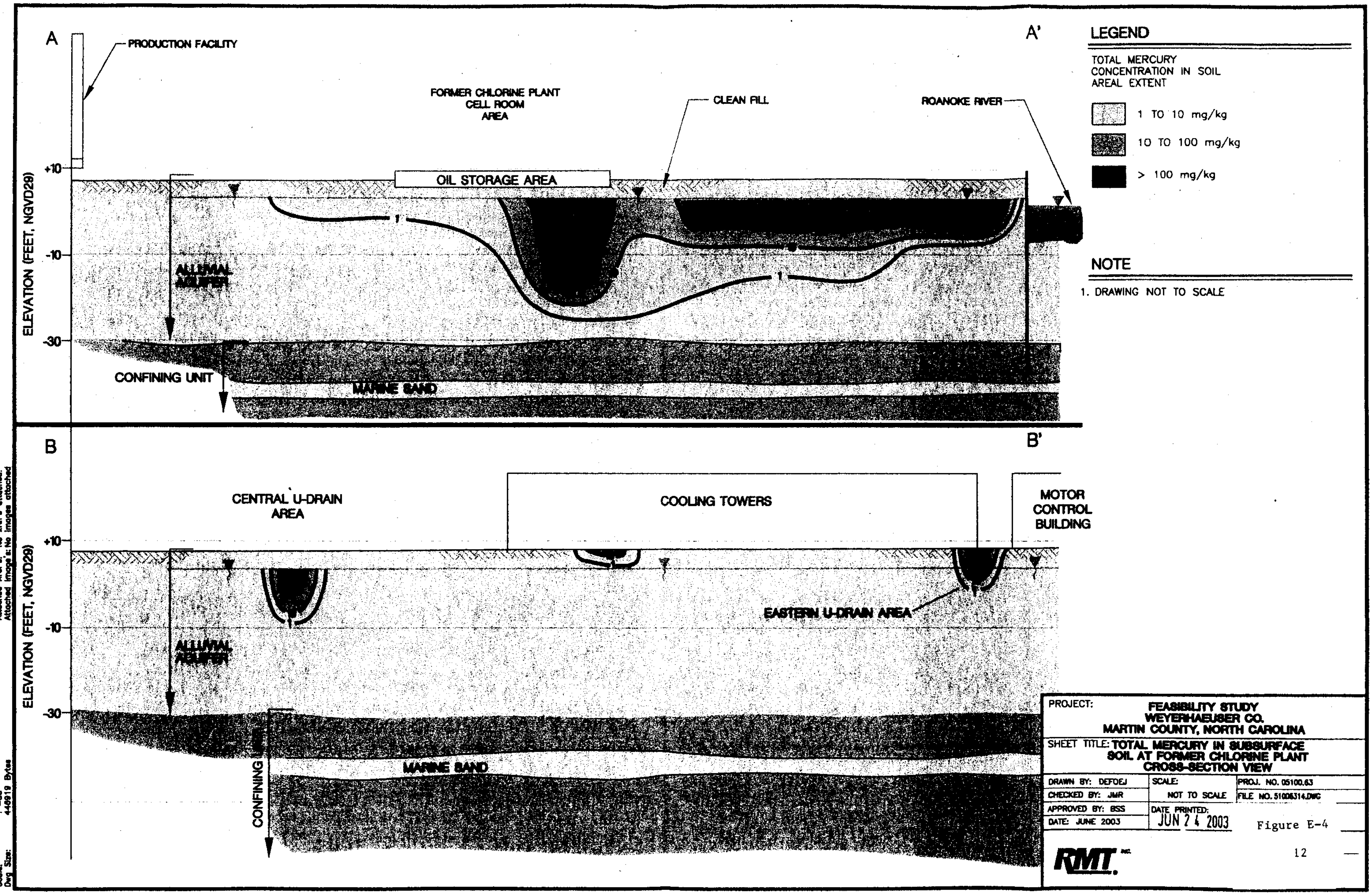

Figure E-4

12

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Attached Image's: No images attached.

Table E-1
Former Chlorine Plant
Mercury Detected in RI Surface Soil

BORING I.D.	SAMPLE DEPTH (ft bgs)	MERCURY (mg/kg)
CPSS-01	0-0.5	4.1 u/3.6 u[1]
CPSS-02	0-0.5	0.53 u
CPSS-03	0-0.5	7.3

u = laboratory result judged to be not detected based on data validation.

(1) Second value is a duplicate result.

Table E-2
Former Chlorine Plant
Mercury Detected in RI Subsurface Soil

BORING I.D.	SAMPLE DEPTH (ft bgs)	ELEVATION (ft NGVD29)	SOIL CONCENTRATION (mg/kg)	
			MERCURY	METHYL MERCURY
CPSB-01	**4.0 - 5.5**	4.0 to 2.5	5.0	0.155
	14.0 - 14.5	-6.0 to -6.5	0.71	0.0121
	28.0 - 30.0	-20.0 to -22.0	50.3	0.000339
	36.5 - 37.5	-28.5 to -29.5	<0.05	0.000383
	44.0 - 45.0	-36.0 to -37.0	0.51	0.000152 u
CPSB-02	**4.0 - 5.5**	4.0 to 2.5	192	0.112 /0.116 (1)
	14.0 - 15.5	-6.0 to -7.5	20.5	0.0107
	31.0 - 32.0	-23.0 to -24.0	0.1	<0.000087
	36.0 - 37.5	-28 to -29.5	0.46	0.000239
	44.0 - 45.5	-36.0 to -37.5	0.53	<0.000087
CPSB-03	**4.0 - 5.5**	4.0 to 2.5	45800	--
	12.0 - 13.5	-4.0 to -5.5	2.9	--
	21.0 - 21.5	-13.0 to -13.5	6370	--
	36.5 - 37.5	-28.5 to -29.5	328	--
	44.0 - 45.5	-36.0 to -37.5	74.7/4.0 (1)	--
CPSB-04	**4.0 - 5.5**	4.0 to 2.5	389	0.206
	14.0 - 15.0	-6.0 to -7.0	5970	0.0209
	23.0 - 24.0	-15.0 to -16.0	1210	0.103
	31.0 - 32.5	-23.0 to -24.5	0.23 u	0.000041
	36.0 - 37.5	-28.0 to -29.5	0.28 u	0.000225
	44.0 - 45.5	-36.0 to -37.5	0.20 j	0.000094
CPSB-05	**4.0 - 7.5**	4.0 to 0.5	11.6 *j/8.8 (1)	--
	14.0 - 15.5	-6.0 to -7.5	<0.04 *j	--
	26.0 - 27.2	-18.0 to -19.2	0.07 *j	--
CPSB-06	**4.0 - 8.0**	4.0 to 0.0	3.6	0.000591/0.000959 (1)
	12.0 - 16.0	-4.0 to -8.0	0.39	0.00179
	26.0 - 26.5	-18.0 to -18.5	0.11	<0.000087
CPSB-07	**4.0 - 5.5**	4.0 to 2.5	1.0 *j	--
	12.0 - 13.5	-4.0 to -5.5	1.1 *j	--
	20.0 - 26.0	-12.0 to -18.0	0.43 *j	--
CPSB-08	**4 .0- 5.5**	4.0 to 2.5	0.45 *j/0.60 (1)	--
	13.5 - 15.0	-5.5 to -7.0	0.25 *j	--
	20.0 - 20.5	-12.0 to -12.5	0.25 *j	--
CPSB-09	**4.0 - 5.5**	4.0 to 2.5	6.7	0.00368
	14.0 - 15.0	-6.0 to -7.0	105	0.0345
	21.5 - 23.0	-13.5 to -15.0	2.4	0.000308
CPSB-10	**4.0 - 7.5**	4.0 to 0.5	9.3 *j/10.5 *j(1)	0.0266
	16.0 - 17.5	-8.0 to -9.5	1.4 *j	0.00205
	20.0 - 21.0	-12.0 to -13.0	2.1 *j	0.00617

(1) Second value is a duplicate result.
* = duplicated analysis not within control limits.
j = concentration considered an estimate based on data validation.
u = laboratory result judged to be not detected based on data validation.
< = concentration less than the Quantitation Limit.
-- = not analyzed.
NS = not sampled, the boring encountered refusal at a depth of 2.5 feet in three attempts.

Table E-2
Former Chlorine Plant
Mercury Detected in RI Subsurface Soil

BORING I.D.	SAMPLE DEPTH (ft bgs)	ELEVATION (ft NGVD29)	SOIL CONCENTRATION (mg/kg)	
			MERCURY	METHYL MERCURY
CPSB-11	4.0 - 8.0	4.0 to 0.0	8.6 *j/4.8 *(1)	--
	12.0 - 13.0	-4.0 to -5.0	0.56	--
	20.0 - 21.0	-12.0 to -13.0	0.14	--
CPSB-12	6.0 - 7.0	2.0 to 1.0	14.3	--
	12.0 - 13.5	-4.0 to -5.5	1.9	--
	23.0 - 24.5	-15.0 to -16.5	2.1	--
CPSB-13	4.0 - 8.0	4.0 to 0.0	60.8	0.0386/0.0133 (1)
	12.0 - 13.0	-4.0 to -5.0	47.1	0.00991
	20.0 - 20.5	-12.0 to -12.5	0.15	0.0102
CPSB-14	4.3 - 4.7	3.7 to 3.3	601	0.0946
	13.0 - 13.5	-5.0 to -5.5	22	0.0271
	23.5 - 24.0	-15.5 to -16.0	1.3	0.000246
CPSB-15	3.8 - 4.8	4.2 to 3.2	1.7 *j	--
CPSB-16	4.2-5.0	3.8 to 3.0	72.4 *j	--
CPSB-17	4.2-8.0	3.8 to 0.0	0.40 *j	--
	12.0-16.0	-4.0 to -8.0	0.88 *j	--
	20.0-24.0	-12.0 to -16.0	1.0 *j	--
CPSB-18	7.0-8.0	1.0 to 0.0	2.6 *j	--
CPSB-19	6.5 - 7.0	1.5 to 1.0	9.4 *j	--
CPSB-20	6.5 - 7.0	1.5 to 1.0	50.5 *j	--
CPSB-21	4.0 - 8.0	4.0 to 0.0	3140 *j	--
	12.0 - 16.0	-4.0 to -8.0	2.8 *j	--
	20.0 - 24.0	-12.0 to -16.0	3.6 *j	--
CPSB-22	4.0 - 8.0	4.0 to 0.0	0.080 B*j	--
	12.0 - 16.0	-4.0 to -8.0	0.19 *j	--
	20.0 - 22.0	-12.0 to -14.0	1.9 *j	--
CPSB-24	6.0 - 7.0	2.0 to 1.0	2.6 Nj	--
CPSB-25	NS	--	--	--

(1) Second value is a duplicate result.
* = duplicated analysis not within control limits.
j = concentration considered an estimate based on data validation.
u = laboratory result judged to be not detected based on data validation.
< = concentration less than the Quantitation Limit.
-- = not analyzed.
NS = not sampled, the boring encountered refusal at a depth of 2.5 feet in three attempts.

b. Groundwater

Of the 29 monitoring wells which were installed in the immediate area of the Former Clorine Plant, the North Carolina Maximum Acceptable Concentration (NCMAC) for mercury in groundwater of 1.1 μg/kg was exceeded at six locations. In general, the highest mercury concentrations were observed at the water table beneath the former mercury cell room and U-drain system. The six monitoring wells with concentrations of mercury above the NCMAC were shallow wells within the Former Chlorine Plant building footprint or immediately downgradient. Lower concentrations were measured in deeper samples, from the middle alluvial aquifer and from the marine sand. None of the groundwater samples collected from the deeper wells exceeded the NCMAC.

The mercury-containing groundwater is in direct contact with the mercury-containing soil located within the alluvial aquifer, which extends from approximately 4 to 40 feet below the ground surface. Mercury concentrations decrease by an order of magnitude approximately 50 feet from the Former Chlorine Plant footprint and are at or below the NCMAC within 50 feet to the east and west of the footprint area. Total mercury concentrations from 13 monitoring wells at the water table ranged from 0.002 μg/kg to 116 μg/kg. Methyl mercury was quantified in selected groundwater samples at concentrations averaging 0.0 to 2 percent of the total mercury concentrations. The results of groundwater sampling during the RI are presented in **Table E-3.**

c. Sediment

Sediment core samples were collected at 10 locations within the Roanoke River adjacent to the Former Chlorine Plant Area. The cores were divided into four samples, with three samples evenly spaced in the upper soft sediment, and with the deepest sample coming from the underlying alluvial aquifer sand. Total mercury concentrations ranged from <0.05 mg/kg to 291 mg/kg. The thickness of soft sediment ranged from 4.2 feet to 13.9 feet, with an average depth of 10.1 feet.

The areal distribution of the mercury in sediment does not directly correspond to the locations of the historical drains from the Former Chlorine Plant. The highest mercury concentrations were found over 250 feet upstream of the central discharge, at depths of approximately 8 feet within the soft sediment column. Lower concentrations were found at all locations in the overlying sediment, providing evidence of continuing deposition of material with less mercury over time. There was an area of buried sediment (depths of 9 to 10 feet) with mercury concentrations between 10 and 70 mg/kg that is adjacent to the bulkhead and downstream of the central and eastern historical U-drains.

Possible hypotheses for the areal distribution of mercury in the sediment are resuspension and deposition of sediment due to construction activities related to the bulkhead extension, and/or due to historical barge loading operations that occurred along the bulkhead near the Former Chlorine Plant.

The vertical distribution of mercury was also variable across the area sampled. With the exception of the core sample collected at CPSD-06, the highest concentrations of mercury were quantified in soft sediment from either the second or third depth collected. One possible explanation for the vertical mercury profile detected during the RI is the deposition of clean sediment over these areas in the 30+ years since the Former Chlorine Plant ceased operations.

Methyl mercury concentrations in sediment were not found with the highest total mercury concentrations. A higher percentage of methyl mercury compared with total mercury occurred in the upper one or two sample depths. However, the actual concentration of methyl mercury is generally proportional to the total mercury, ie: samples with higher mercury levels also had higher methyl mercury levels. The percent of mercury that is present as methyl mercury in the sediment of the Roanoke River is at the low end of literature reported values for marine and estuarine sediment. Although methylation of mercury typically takes place in the top layers of sediment, this was not what was found during the RI. The conclusion presented in the RI was that the methylation of the mercury occurred historically, and like the sediments containing higher mercury concentrations, the sediment was then covered through burial.

Mercury and methly mercury concentrations detected in Roanoke River sediment during the RI are presented in **Table E-4**.

Table E-3
Former Chlorine Plant
Mercury Detected in Groundwater

WELL SCREEN INTERVAL	WELL I.D.[1]	SAMPLE DATE	MERCURY[2] (μg/L)	METHYL MERCURY (μg/L)
Alluvial aquifer (water table)	MW-1B	3/2/99	1.6	0.00343
		4/26,29/99	2.8	0.00374
	CP-02-1	3/1,2/99	3.5	0.00136
		4/29/99	0.94	0.00204
	CP-03-1	2/28,3/3/99	<0.11	0.000269
		4/28/99	<0.10	0.000790
	CP-04-1	3/1/99	116	1.675
		4/27,28/99	49.9	0.2573
	CP-05-1	3/4/99	9.6	0.728
		4/29/99	11.6	1.16 j
	CP-06-1	5/3/99	90.9	0.327
	CP-07-1	5/3/99	1.1	0.00517
	CP-08-1	5/3/99	0.56	0.00566
	CP-09-1	10/19/99	0.0174	--
	CP-10-1	10/21/99	0.0222	--
	CP-11-1	10/20/99	0.00212	--
	CP-12-1	10/20/99	0.00674	--
	MW-2	10/14/99	0.00399	--
	CPGP-01-1	10/11/99	1	--
	CPGP-02-1	10/11/99	0.3/0.3[3]	--
	CPGP-03-1	10/12/99	2.3	--
	CPGP-04-1	10/12/99	<0.2	--
	CPGP-05-1	10/12/99	<0.2	--
	CPGP-06-1	10/13/99	<0.2	--
	CPGP-07-1	10/13/99	<0.2	--
	CPGP-08-1	10/13/99	0.0364	--
	CPGP-09-1	10/13/99	0.267	--
	CPGP-10-1	10/13/99	<0.2	--
	CPGP-11-1	10/13/99	<0.2	--
	CPGP-12-1	10/14/99	<0.2	--
	CPGP-13-1	10/14/99	1.9/2.4[3]	--
Alluvial aquifer (-20 foot elevation)	CP-01-2	3/2/99	<0.11/<0.11[3]	0.000619/0.000049 u[3]
		4/26/99	0.334	0.000403
	CP-02-2	3/1/99	<0.11	0.000160 u
		5/5/99	0.0301	0.000115
	CP-03-2	3/3/99	<0.11	0.000144 u
		4/26/99	0.0248	0.000119
	CP-04-2	3/1/99	0.43	0.00124
		4/26/99	0.399/0.176[3]	0.00176/0.00123[3]
	CP-05-2	3/2/99	<0.11	0.000619
		4/26/99	0.0970	0.000369
	CP-06-2	5/3/99	0.21 B	0.00843
	CP-07-2	5/3/99	0.19 B	0.00131
	CP-08-2	5/3/99	<0.10	0.00101

Table E-3
Former Chlorine Plant
Mercury Detected in Groundwater

WELL SCREEN INTERVAL	WELL I.D.[1]	SAMPLE DATE	MERCURY[2] (µg/L)	METHYL MERCURY (µg/L)
Alluvial aquifer (-20 foot elevation) (continued)	CP-09-2	10/19/99	0.137	--
	CP-10-2	10/21/99	0.0159	--
	CP-11-2	10/20/99	0.0512/0.0472[3]	--
	CP-12-2	10/20/99	0.102	--
	MW-2-2	10/20/99	0.0581	--
	CPGP-01-2	10/11/99	<0.2	--
	CPGP-02-2	10/12/99	<0.2	--
	CPGP-03-2	10/12/99	<0.2	--
	CPGP-04-2	10/12/99	<0.2	--
	CPGP-05-2	10/12/99	<0.2	--
	CPGP-06-2	10/13/99	<0.2	--
	CPGP-07-2	10/13/99	<0.2/<0.2[3]	--
	CPGP-08-2	10/13/99	<0.2	--
	CPGP-09-2	10/13/99	<0.2	--
	CPGP-10-2	10/13/99	<0.2	--
	CPGP-11-2	10/13/99	<0.2	--
	CPGP-12-2	10/14/99	0.2	--
	CPGP-13-2	10/14/99	<0.2	--
Marine sand	CP-01-3	3/2/99	<0.11	0.00005 u
		4/26/99	0.0475	0.000324
	CP-03-3	3/3/99	45[4]	0.000019 u
		4/26/99	0.0180	0.00006
		10/20/99	0.0194	--
	CP-04-3	3/1/99	<0.11	0.000036 u
		4/26/99	0.00172	0.000011

(1) I.D. numbers with the CPGP- prefix indicate one-time grab sample of groundwater from direct-push borings.
(2) Shaded values indicate an exceedence of the North Carolina groundwater quality standard of 1.1 µg/L (15A NCAC 2L.0202).
(3) Second value is a duplicate result.
(4) Value of 45 is a suspected laboratory or sampling error given the 2000-fold difference in the latter two sampling rounds.
B = less than the required detection limit but greater than the Instrument Detection Limit.
j = concentration considered an estimate based on data validation.
u = laboratory result judged to be not detected based on data validation.
< = concentration less than the Quantitation Limit.
-- = not analyzed or measured.

Table E-4
Mercury Detected in Roanoke River Sediment

BORING I.D.	DEPTH BELOW SEDIMENT SURFACE (ft)	SEDIMENT CONCENTRATION(mg/kg)	
		MERCURY	METHYL MERCURY
CPSD-01	0 - 0.5	0.54	0.000639
	1.9 - 2.4	1.7	0.00205
	3.9 - 4.4	5.0	0.0252
	7.4 - 7.9	3.5	0.00318
CPSD-02	0 - 0.5	0.11	0.000348
	5.6 - 6.1	0.23	0.000731
	11.1 - 11.6	0.36	0.000276
	14.1 - 14.6	0.07	0.000011
CPSD-03	0 - 0.5	0.1/0.1 (1)	0.000339/0.000451 (1)
	6.5 - 7.0	0.29	0.000413
	12.0 - 12.5	0.06 B	0.000012
	14.0 - 14.5	0.07	0.000067
CPSD-04	0 - 0.5	0.20	0.000508
	4.2 - 4.7	0.29	0.000526
	6.7 - 7.2	291	0.0553
	10.2 - 10.7	0.10	0.000062
CPSD-05	0 - 0.5	0.18	0.000463
	3.5 - 4.0	0.20	0.000585
	7.5 - 8.0	127/111 (1)	0.0406/0.0361 (1)
	8.7 - 9.5	0.41	0.000777
CPSD-06	0 - 0.3	0.77	0.000943
	4..3 - 4.8	0.38	0.000271
	7.3 - 7.8	1.0	0.00315
	9.8 - 10.5	69.5	0.01
CPSD-07	0 - 0.3	0.22	0.000721
	5.8 - 6.3	0.65/0.48	0.000497/0.000379 (1)
	10.8 - 11.3	0.12	0.000141
	12.8 - 13.3	0.11	0.000158
CPSD-08	0 - 0.5	0.11	0.000271
	6.0 - 6.5	1.0	0.00291
	11.5 - 12.0	118	0.00723
	14.2 - 14.7	0.09 Bu	0.00033
CPSD-09	0 - 0.5	0.35	0.00294
	3.5 - 4.0	1.6	0.0222
	8.5 - 9.0	17.9/8.3	0.00266/0.00211
	9.0 - 9.5	0.65	0.001055
CPSD-10	0 - 0.5	0.13	0.000347
	7.0 - 7.5	6.2	0.000271
	14.0 - 14.5	0.23	0.000361
	16.0 - 16.5	<0.05	<0.000048

B = less than the required detection limit but greater than the Instrument Detection Limit.
u = laboratory result judged to be not detected based on data validation.
< = concentration less than the Quantitation Limit.
-- = not analyzed.
(1) Second value is a duplicate result.

F. Contaminant Fate and Transport

The potential routes of migration from the various media in the Former Chlorine Plant Area are as follows:

- Migration of mercury from surface soil to surface water
- Volatilization of mercury from surface soil to air
- Migration of mercury from subsurface soil to groundwater
- Discharge of groundwater containing dissolved mercury into the Roanoke River

The potential for these routes of migration to be completed and the details associated with them are discussed in the following sections. The potential migration of mercury containing sediments downstream within the Roanoke River is being assessed as part of the Roanoke River Remedial Investigation, Operable Unit-2.

1. Surface Soil

The Former Chlorine Plant Area is mostly covered with asphaltic concrete pavement and concrete. The covering reduces run-off, volatilization to the air and leaching from soil to groundwater. Uncovered soil is present near the bulkhead, where a small grass-covered strip is located adjacent to the bulkhead. Mercury was detected at one surface soil sample taken during the RI at 7.3 mg/kg, and previous sampling detected mercury levels as high as 59.8 mg/kg. The potential routes of migration from the grass covered strip are through surface water runoff and volatilization. Surface water runoff is not likely to contain significant amounts of mercury because the ground surface is flat, the soil is sandy, and the mercury levels present in surface soil are low. In addition, significant volatilization of mercury from the soil is not expected. Since the mercury in soil has been present for decades, any elemental mercury (the source of greatest volatilization potential) would have long since volatilized. Also, since the levels of total mercury in the soil are low, this would not be a significant source.

2. Subsurface Soil to Groundwater

Groundwater flow patterns beneath the Former Chlorine Plant are complex due to the presence of two mounds in the water table possibly created by leakage from a cooling tower used in the present manufacturing operations. In addition, there are numerous storm water drains and process water drains in the area of the Former Chlorine Plant.

The highest concentrations of total mercury in groundwater are present in the vicinity of the high soil concentrations below the former mercury cells and associated U-drains. As groundwater flows through these high concentrations of mercury in the soil, the mercury is leached from the soil and dissolves in the groundwater. Dissolved mercury is then carried through the aquifer with the groundwater flow. The potential leaching effect was confirmed during the RI by using a Modified Synthetic Precipitation Leaching Procedure. The results are shown in **Figure F-1**. As presented in the graph, the total mercury in the "leachate" increases with increasing mercury concentration.

Small beads of elemental mercury were observed in saturated soil beneath the center of the Former Chlorine Plant Area. Given the low water solubility of elemental mercury, this mercury could serve as an ongoing source of dissolved mercury to the groundwater.

3. Groundwater to the Roanoke River

Groundwater originating beneath the Former Chlorine Plant travels in several directions as follows:

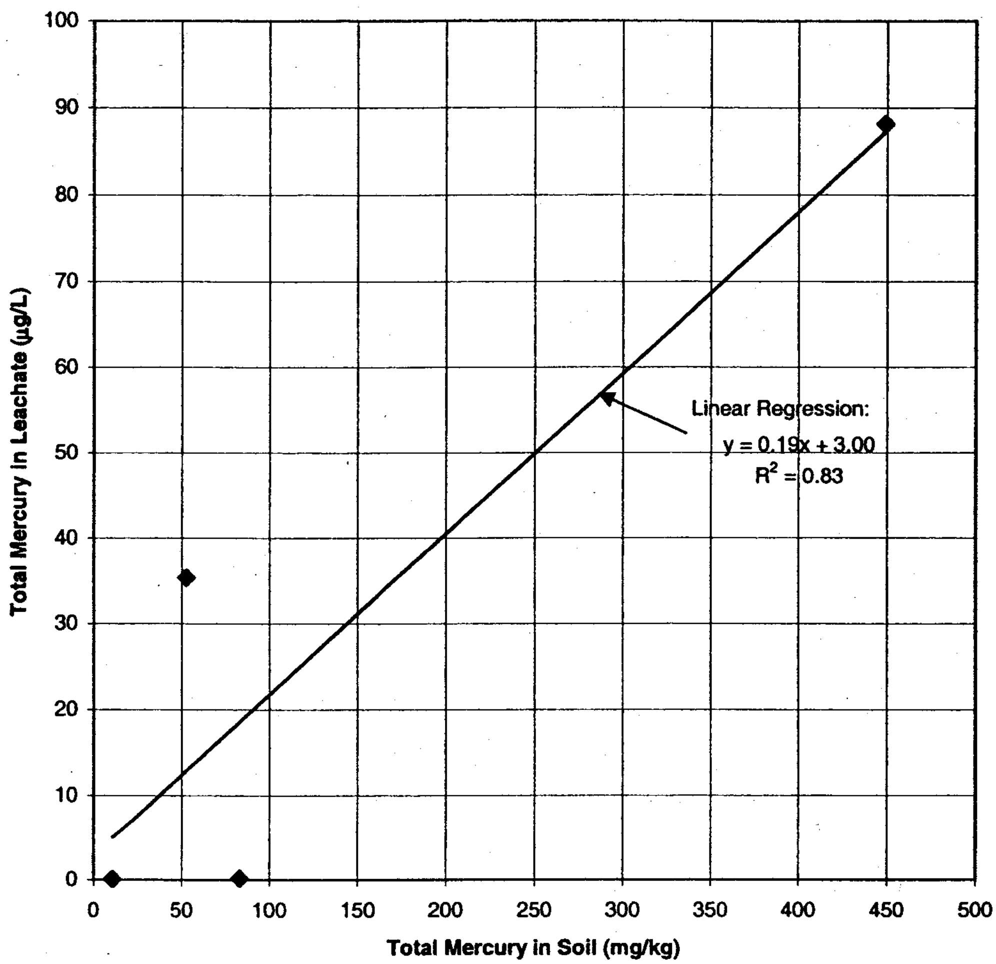
- To the north and west, toward the bulkhead and the Roanoke River
- To the south-southeast as a result of the mound near the cooling towers, eventually discharging to the Roanoke River to the north, due to the influence of regional groundwater flow.

Vertical hydraulic gradients beneath the river along most of the bulkhead are upward, therefore, groundwater flowing northward may be entering the Roanoke River through leaks in the sheet pile bulkhead. This is possible due to the age and intended design of the bulkhead. Groundwater flowing to the south-southeast discharges to the Roanoke River to the east of the Former Chlorine Plant Area, but this full migration route has not been defined.

An estimate of the mercury flux from the Former Chlorine Plant Area was made during the RI using groundwater flow data and chemistry data. The flow system was divided into three parts on the basis of hydraulic conductivity: the shallow alluvial aquifer, the deep alluvial aquifer, and the marine sand. The combined mass of mercury discharging from the Former Chlorine Plant Area is estimated to be 0.012 pounds per year. There is significant uncertainty in the calculation due to oversimplified assumptions. Applying an uncertainty factor of ± 10 provides a range of 0.0012 to 0.12 pounds per year.

The potential discharge of mercury to the Roanoke River from the Former Chlorine Plant was also evaluated on a concentration basis. Using an assumption that there is no mercury in the river upstream of the mill, and the Former Chlorine Plant groundwater flux is the only source, results in concentrations of 0.0000001 μg/L to 0.00001 μg/L. These concentrations are 0.0009 to 0.09 percent of the North Carolina surface water quality standard of 0.012 μg/L.

Figure F-1
Former Chlorine Plant
Mercury Leaching Batch Test Results
(Modified Synthetic Precipitation Leaching Procedure)



G. Current and Potential Future Land and Resources Uses

The Former Chlorine Plant Area is located within the property boundary of the active Weyerhaeuser manufacturing facility. The plant is occupies approximately 2,400 acres located 1.5 miles from the Town of Plymouth, North Carolina. The Weyerhaeuser facility is expected to remain an active industrial facility in the future, and site access is controlled by complete perimeter fencing and full time security.

Shallow groundwater in the vicinity of the Former Chlorine Plant is not currently used, and is not expected to be used, as a potable water source. However, the State of North Carolina considers all groundwater to be potentially potable.

The Weyerhaeuser facility is located immediately adjacent to the Roanoke River, approximately 7 miles from the river's confluence with Albemarle sound. The river is used for recreational fishing and boating. Drinking water is not obtained from the surface water of the Roanoke River downstream of Weyerhaeuser. A national wildlife estuary is located across the River on Huff Island, and down river near the Albemarle sound.

H. Summary of Site Risks

The Baseline Human Health Risk Assessment and the Baseline Ecological Risk Assessment present the results of comprehensive risk assessments that addresses the potential threats to public health and the environment posed by the Site under current and future conditions, assuming that no remedial actions take place, and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

1. The Baseline Human Health Risk Assessment

The Baseline Risk Assessment consists of the following sections: identification of chemicals of potential concern; exposure assessment; toxicity assessment; and, risk characterization. All sections are summarized below.

a. Chemicals of Concern (COCs)

The first step involved in the human health risk assessment process is selection of COCs. The COC selection identifies site-related chemicals that are present at concentrations that could result in potential adverse effects on human health.

For the purpose of the baseline risk assessment, the COCs for human health, are mercury and methyl-mercury in soil and groundwater. **Table H-1** presents a summary of the chemicals of concern and their detection in environmental media at the Former Chlorine Plant.

Table H-1
Chemicals of Concern for the
Former Chlorine Plant Area

Media	Chemical of Concern	Concentration Detected Min	Max	Units of Measure	Frequency of Detection
Surface Soil	Mercury	0.1	59.8	mg/kg	3/3
Sub-surface Soil	Mercury	0.08	45,800	mg/kg	168/204
	Methyl-mercury	0.000959	0.206	mg/kg	5/8
Groundwater	Mercury	0.43	116	μg/L	13/24
	Methyl-mercury	1.6 E^{-3}	1.68	μg/L	7/13

b. Exposure Assessment

The second step of the risk assessment process, the Exposure Assessment, involves identifying the human populations that may be exposed to COCs in environmental media and the routes by which they may be exposed. The exposure assessment is finalized with the estimate of the daily dose of COCs to which receptors may be exposed.

The objective of the exposure assessment is to estimate the type and magnitude of potential exposures to COCs in environmental media associated with the Former Chlorine Plant Area. The exposure assessment for the Former Chlorine Plant Area follows the guidance in Risk Assessment Guidance for Superfund (RAGS) (EPA, 1989) and addresses the following:

- Characterization of the exposure setting
- Identification of migration and exposure pathways
- Quantification of exposure

Characterization of Exposure Setting

The location and setting of the Former Chlorine Plant Area was presented earlier. As a component of characterizing the exposure setting for the Former Chlorine Plant Area, potential human receptors and their expected types of exposure to the constituents present at the site were identified for current and hypothetical future land use scenarios. These potential human receptors represent those segments of the population most likely to come into contact with the COCs present in environmental media at the Former Chlorine Plant Area. Given the location of the Former Chlorine Plant Area human populations that may potentially be exposed to COCs under the current land use scenario are limited to the industrial worker and the construction worker. Fencing, and extensive facility security, eliminated the potential trespasser scenario.

Shallow groundwater in the vicinity of the Former Chlorine Plant is not currently used, and is not expected to be used, as a potable water source. Therefore, potential groundwater ingestion pathways are considered incomplete for all receptors under consideration for current land uses, and as such, were not quantitatively evaluated in the risk assessment for those receptors. Even though shallow groundwater is not used currently as a potable source and is unlikely to be accessible for future use, the shallow groundwater in the vicinity of Former Chlorine Plant Area is considered potable by the State of North Carolina.

Identification of Migration and Exposure Pathways

The conceptual site model for Former Chlorine Plant Area (**See Figure E-1)** is based on characterization of waste sources, the COCs for each affected environmental medium, and the migration and transport potential of this constituent to potential receptors.

An exposure pathway is the means by which a constituent moves from a source to a receptor. A completed exposure pathway has the following elements:

1. **Constituent Source**-The primary remaining known sources of site-related constituents in environmental media in the Former Chlorine Plant Area is mercury and methyl-mercury in soil and groundwater.

2. **Mechanism for constituent release and environmental transport medium** - The potential constituent release and transport pathways relevant to human health at the Former Chlorine Plant Area are as follows:

   - Mercury and methyl-mercury in surface and subsurface soils that can migrate to groundwater;

   - Discharge of groundwater containing mercury and methyl-mercury to the sediments and surface water of the Roanoke River; and

   - Mercury accumulation in sediment from groundwater discharge.

3. **Feasible route of potential exposure**-Completed exposure pathways are the means by which potentially exposed populations (receptors) come into contact with site-related COCs. The completed exposure pathways

evaluated under current land use scenarios for potential human receptors at the Former Chlorine Plant Area were as follows:

- Industrial worker exposure (ingestion, dermal contact, inhalation) to mercury in uncovered surface soil

- Incidental construction worker exposure (ingestion, dermal contact, inhalation) to mercury in subsurface soil and dermal contact with groundwater.

Quantification of Exposure

The potential exposure to site-related COCs for each receptor is represented by a chronic daily intake (CDI). The CDI for an individual receptor is estimated from the exposure point concentration of each COC in each environmental medium.

Exposure Point Concentration

Consistent with Region 4 Supplemental Guidance (EPA, 1996), the exposure point concentrations used for estimating CDIs are the lesser of the maximum concentration for each COC or the 95 percent upper confidence limit (95% UCL) of the mean concentration assuming a log-normal distribution of the data set. A value equivalent to one-half the Quantitation Limit was used in the exposure point concentration calculations for constituents reported as not detected. The exposure point concentrations for the COCs from the various environmental media are presented in **Table H-2**.

Table H-2
Exposure Point Concentrations

Environmental Media	Mercury Species	Maximum Observed Concentration	Calculated 95% Upper Confidence Level	Exposure Point Concentration
Surface Soil	Mercury	7.3 mg/kg	(1)	7.3 mg/kg
Subsurface Soil	Mercury	45,800 mg/kg	767 mg/kg	767 mg/kg
	Methyl mercury	0.206 mg/kg	22.5 mg/kg	0.206 mg/kg
Groundwater	Mercury	116 μg/L	220 μg/L	116 μg/L
	Methyl mercury	1.65 μg/L	1,530 μg/L	1.65 μg/L
Surface Soil-future use	Mercury	59.8 mg/kg	12.7 mg/kg	12.7 mg/kg

(1) Only three surface soil samples were collected during the RI. Given the small sample data set, the maximum observed concentration was used as the exposure point concentration

CDI

A CDI is the exposure expressed as the mass of a substance contacted per unit body weight per unit time, averaged over a period of years. The CDIs for COCs at the Former Chlorine Plant Area were calculated to represent both the RME and the potential average or central tendency exposure. The RME doses are defined as the "maximum exposure that is reasonably expected to occur at the site" (EPA, 1989). The average or central tendency exposure doses are defined as representing more typical exposures that are based on 50th percentile exposure estimates. The exposure variables used to calculate the CDI for each potential receptor for both the RME and the potential average or central tendency exposure are outlined in **Table H-3**. The exposure point concentration relied upon in both the RME and central tendency risk calculations is conservative in that it represents the 95% UCL for each media.

Table H-3
Reasonable Maximum Exposure and Average Exposure Assumptions

EXPOSURE VARIABLE	REASONABLE MAXIMUM EXPOSURE ASSUMPTIONS		AVERAGE EXPOSURE ASSUMPTIONS	
	VALUE	BASIS	VALUE	BASIS
Industrial Worker (Current and Future Land Use)				
Age	Adult		Adult	
Incidental soil ingestion rate	50 mg/day	Region IV Guidance(1)	10 mg/day	Exposure Factors Handbook(2)
Skin surface area available for dermal contact with soil	5,660 cm^2/day	Dermal Exposure Guidance(3)	4,300 cm^2/day	Dermal Exposure Guidance
Adherence factor	1.0 mg/cm^2	Region IV Guidance	0.2 mg/cm^2	Dermal Exposure Guidance
Exposure time	8 hours/day	Region IV Guidance	8 hours/day	Region IV Guidance
Exposure frequency	250 days/year	Region IV Guidance	219 days/year	Central Tendency(2)
Exposure duration	25 years	Region IV Guidance	9 years	Central Tendency for time at one residence(2)
Body weight	70 kg	Region IV Guidance	70 kg	Region IV Guidance

(1) Region IV Guidance: USEPA. October 1996. Supplemental Guidance to RAGS: Region IV Bulletins – Human Health Risk Assessment
(2) Exposure Factors Handbook: USEPA. August 1997. Exposure Factors Handbook. USEPA/600/P-95/002F.
(3) Dermal Exposure Guidance: USEPA. January 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. USEPA/600/8-91/011B.

Table H-3 (Continued)
Reasonable Maximum Exposure and Average Exposure Assumptions

EXPOSURE VARIABLE	REASONABLE MAXIMUM EXPOSURE ASSUMPTIONS		AVERAGE EXPOSURE ASSUMPTIONS	
	VALUE	BASIS	VALUE	BASIS
Construction Worker				
Age	Adult		Adult	
Incidental soil ingestion rate	100 mg/day	Region IV Guidance[(1)]	10 mg/day	Exposure Factors Handbook[(2)]
Skin surface area available for dermal contact (soil and water)	5,660 cm^2/day	Dermal Exposure Guidance[(3)]	4,300 cm^2/day 2,000 cm^2/day for dermal contact with groundwater	Dermal Exposure Guidance[(3)]
Adherence factor	1.0 mg/cm^2	Region IV Guidance[(1)]	0.2 mg/cm^2	Dermal Exposure Guidance[(3)]
Exposure time	10 hours/day 2 hours/day for dermal contact with groundwater	Professional judgment	10 hours/day 2 hours/day for dermal contact with groundwater	Professional judgment
Exposure frequency	250 days/year 25 days/year for dermal contact with groundwater	Region IV Guidance[(1)]	250 days/year 25 days/year for dermal contact with groundwater	Region IV Guidance[(1)]
Exposure duration	1 year	Professional judgment	1 year	Professional judgment
Body weight	70 kg	Region IV Guidance[(1)]	70 kg	Region IV Guidance[(1)]

(1) Region IV Guidance: USEPA. October 1996. Supplemental Guidance to RAGS: Region IV Bulletins - Human Health Risk Assessment
(2) Exposure Factors Handbook: USEPA. August 1997. Exposure Factors Handbook. USEPA/600/P-95/002F.
(3) Dermal Exposure Guidance: USEPA. January 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. USEPA/600/8-91/011B.

c. Toxicity Assessment

There are two purposes of the toxicity assessment: first, to review available information on the potential adverse effects that may result from exposure to the COPC; and second, to quantify the relationship between exposure to these constituents and the likelihood of potential health effects. Toxicity reference values (TRVs) for the COPCs were taken from Integrated Risk Information System (IRIS) and the Health Effect Assessment Summary Table (HEAST).

Toxicity Information for Non-carcinogenic Effects

EPA's preferred (EPA, 1996) toxicity value for evaluating non-carcinogenic effects resulting from chemical exposure is the chronic reference dose (RfD). The chronic RfD is an estimate of a daily exposure level for the human population (including sensitive populations) that should not cause an appreciable risk of harmful effects during a lifetime of exposure. For the Former Chlorine Plant Area baseline human health risk evaluation, mercury and methyl mercury were quantitatively evaluated for non-carcinogenic health effects.

Oral RfDs (RfDO) are published exposure dose estimates derived from ingestion-based studies. RfDO values were used to estimate the potential hazards associated with the incidental ingestion pathway and with modification, the dermal contact pathway. Inhalation RfDs (RfDI) are published exposure dose estimates derived from inhalation based studies and were used to estimate the potential hazard for the inhalation pathway. Toxicity information for the oral route is not available for elemental mercury and as such, a quantitative estimate of risk through oral or dermal pathways cannot be estimated. The available toxicity values for mercuric chloride (the soluble chloride salt of mercury) were evaluated for use as a surrogate. **Table H-4a and H-4b** present a summary of the available quantitative toxicity information for elemental mercury, mercuric chloride, and methyl mercury for the estimation of hazard through incidental ingestion, dermal contact, and inhalation exposure pathways.

Table H-4a
Summary of Noncarcinogenic Toxicity Data - Oral/Dermal

CONSTITUENT OF CONCERN	CHRONIC/ SUBCHRONIC	ORAL RfD VALUE (mg/kg-day)	ORAL TO DERMAL ADJUSTMENT FACTOR[1]	ADJUSTED DERMAL RfD (mg/kg-day)	COMBINED UNCERTAINTY/ MODIFYING FACTORS	SOURCES OF RfD: TARGET ORGAN	DATES OF RfD[2] (mm/dd/yy)
Mercury, elemental	NA	NA	NA	NA	NA	IRIS	11/23/99
Mercuric chloride	Subchronic	3E-04	0.2	6E-05	1,000	IRIS	05/12/00
Methyl mercury	Chronic	1E-04	1.0	1E-04	10	IRIS	11/23/99

(1) Supplemental Guidance to RAGS, USEPA 1996
(2) For IRIS values, date IRIS was searched.
NA Not available.

Table H-4b
Summary of Noncarcinogenic Toxicity Data – Inhalation

CONSTITUENT OF CONCERN	CHRONIC/ SUBCHRONIC	INHALATION RfC VALUE (mg/m³)	ADJUSTED INHALATION RfD [1] (mg/kg-day)	COMBINED UNCERTAINTY/ MODIFYING FACTORS	SOURCES OF RfC:RfD	DATES [2] (mm/dd/yy)
Mercury, elemental	Subchronic	3.0E-04	8.6E-05	30	IRIS	11/23/99
Mercuric chloride	NA	NA	NA	NA	IRIS	05/12/00
Methyl mercury	NA	NA	NA	NA	IRIS	11/23/99

(1) For noncarcinogenic compounds: Inhalation RfD (mg/kg-day) = RfC (mg/m^3) x $(70\ kg)^{-1}$ x 20 m^3/day, Supplemental Guidance to RAGS, USEPA 1996
(2) For IRIS values, date IRIS was searched.
NA Not available.

Toxicity Information for Carcinogenic Effects

Carcinogenic toxicity values for elemental mercury, mercuric chloride, and methyl mercury are not available in the IRIS. As a result, incremental carcinogenic risk was not estimated during the risk assessment. Mercury, as elemental or metallic mercury, is identified as a Class D carcinogen; in other words, it is not classifiable as a human carcinogen. This classification is based on the absence of adequate human and animal data that show a correlation between exposure to metallic mercury vapor and carcinogenicity.

Mercury, as mercuric chloride, is identifiable as a Class C carcinogen. Class C indicates that mercuric chloride is a possible human carcinogen indicating inadequate data in humans and limited evidence of carcinogenicity in animals. No data are available on the carcinogenic effects of mercuric chloride in humans. Similar to mercuric chloride, methyl mercury is identified as a Class C carcinogen; a possible human carcinogen based on inadequate data in humans and limited evidence of carcinogenicity in animals. Three human studies were identified in the IRIS that examined the relationship between methyl mercury exposure and cancer. No persuasive evidence of increased carcinogenicity attributable to methyl mercury exposure was observed in any of the studies.

Absorbed Doses

Reference doses and slope factors are calculated based on toxicity testing that involves ingestion of the constituent being evaluated. It has been recognized that many constituents are not 100 percent absorbed through the gastrointestinal system. To utilize oral toxicity values (e.g., RfD_O) in estimating hazards associated with dermal contact exposures, it is necessary to apply a dermal correction factor to RfD_O when they are applied to absorbed intake values. A dermal correction factor of 10 percent was utilized for inorganic mercury (based on divalent mercury: ATSDR, 1994). A dermal correction factor of 100 percent was utilized for mercuric chloride and methyl mercury (ATSDR, 1994).

d. Human Health Exposure and Risk Calculations

In the baseline risk characterization, the results of the toxicity and exposure assessments are summarized and integrated into quantitative and qualitative expressions of potential risk for carcinogenic compounds and into a HI for non-carcinogenic compounds. The baseline risk characterization presents reasonable maximum exposure (RME) and average/central tendency exposures to baseline site conditions in the absence of additional site controls or remediation.

Non-carcinogenic Hazard

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non- carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contamiants and exposure routes, toxic non carcinogenic effects from all contaminants are unlikely. An HI >1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (e.g., chronic, sub-chronic, or short-term). **Table H-5a and H-5b** present a summary of the Noncarcinogenic Hazard Indices for the Former Chlorine Plant Area.

Table H-5a
Summary of Estimated Noncarcinogenic Hazard Indices
Based on RME Exposure Assumptions

POTENTIALLY EXPOSED POPULATION	ESTIMATED NONCARCINOGENIC HAZARD	
	TOTAL MERCURY AS INORGANIC MERCURY	TOTAL MERCURY AS MERCURIC CHLORIDE
Industrial worker (current land use)		
Total surface soil hazard	0.0000013	0.019
Total industrial worker hazard	**0.0000013**	**0.019**
Industrial worker (future land use)		
Total surface soil hazard	0.0000022	0.032
Total industrial worker hazard	**0.0000022**	**0.032**
Construction worker		
Total surface soil hazard	0.000014	0.053
Total subsurface soil (0-10 ft) hazard	0.003	3.2
Total groundwater hazard	0.0019	0.22
Total construction worker hazard	**0.0049**	**3.5**

(1) A noncarcinogenic hazard of less than 1.0 indicates that no significant noncarcinogenic hazard is likely, even for sensitive members of the population.
(2) Range of potential HQ presented for potential exposures to total mercury in affected media which reflects inorganic mercury toxicity values and the requested surrogate mercuric chloride toxicity values.

Table H-5b
Summary of Estimated Noncarcinogenic Hazard Indices
Based on Central Tendency Exposure Assumptions

POTENTIALLY EXPOSED POPULATION	ESTIMATED NONCARCINOGENIC HAZ[illegible]	
	TOTAL MERCURY AS INORGANIC MERCURY	TOTAL MER[illegible] MERCURIC CHLORID[illegible]
Industrial worker (current land use)		
Total surface soil hazard	0.0000011	0.003
Total industrial worker hazard	**0.0000011**	**0.003**
Industrial worker (future land use)		
Total surface soil hazard	0.0000019	0.0052
Total industrial worker hazard	**0.0000019**	**0.0052**
Construction worker		
Total surface soil hazard	0.000011	0.006
Total subsurface soil (0-10 ft) hazard	0.0009	0.36
Total groundwater hazard	0.0007	0.076
Total construction worker hazard	**0.0016**	**0.44**

(1) A noncarcinogenic hazard of less than 1.0 indicates that no significant noncarcinogenic hazard is likely, even for sensitive members of the population.
(2) Range of potential HQ presented for potential exposures to total mercury in affected media which reflects inorganic mercury toxicity values and the requested surrogate mercuric chloride toxicity values.

e. Summary of Risk Characterization

As indicated in **Table H-5a** the range of total industrial worker HIs under current and hypothetical future land use conditions, representing both RME and central tendency/average exposure assumptions, was less than 1. The total HI for the industrial worker was based on a summation of pathway HIs for the incidental ingestion of surface soil, dermal contact with surface soil, and the inhalation of airborne soil particulates.

As indicated in **Table H-5b**, the range of total construction worker HIs representing central tendency/average exposure assumptions was less than 1. The range of total construction worker HIs reflecting reasonable maximum exposures ranged from below 1 ($HI_{\text{inorganic mercury}}$ = 0.0039) to greater than 1 ($HI_{\text{mercuric chloride}}$ = 2.3). The total HI for the construction worker was based on a summation of pathway HIs for the incidental ingestion of surface and subsurface soil, dermal contact with surface soil, inhalation of airborne soil particulates, and incidental dermal contact with groundwater.

The results of the baseline risk evaluation for the Former Chlorine Plant Area indicate that exposure to affected media in the area does not present unacceptable hazard to industrial workers, if site use and conditions remain as they currently are. Industrial workers are not exposed to the high levels of mercury present in the subsurface soils, so only the surface soil sample results were used in the risk evaluation. The results of the risk evaluations of potential construction activities in the area indicate that reasonable maximum exposures could result in a potential hazard for this receptor in the absence of additional site controls or modified work practices.

f. Uncertainty Analysis

The primary goal of the uncertainty analysis is to provide a discussion of the key assumptions made in the risk assessment that may significantly influence the estimate of potential risk. A discussion of the sources of uncertainty contributing to the potential risk and the associated effects (overestimation or underestimation of risk) of these factors is presented in this section.

In the absence of empirical- or site-specific data, assumptions are developed based on best estimates of exposure or dose-response relationships. To assist in the development of these estimates, EPA (1989, 1991) recommends the use of guidelines and standard factors in risk assessments conducted under CERCLA. The use of these standard factors is intended to promote consistency among risk assessments where assumptions must be made. Although the use of standard factors undoubtedly promotes comparability, their usefulness in accurately predicting potential risk is directly related to their applicability to the actual site-specific conditions. **Table H-6** summarizes the assumptions of the risk assessment that affect the estimates of exposure and potential risk.

Table H-6
Uncertainties in Risk Assessment

SOURCE OF UNCERTAINTY	EFFECT ON ESTIMATE OF EXPOSURE
Exposure point concentrations may not represent actual exposure.	May overestimate or underestimate exposure.
Assumes on-site workers spend entire their workdays within, and ingest the entire daily soil dose from, the localized affected areas of the site	Most likely overestimates exposure and resulting estimated risk.
Uses USEPA-approved toxicity values with low confidence ratings and high uncertainty factors.	Most likely overestimates risk.
Uses toxicity values that are largely based on animal studies and extrapolated to humans.	Most likely overestimates risk.
Sampling schemes tended to be biased to areas of probable concern (for example soil samples focused on the areas that were known or suspected to be affected by chemical releases).	Most likely overestimates exposure and resulting estimated risk.
Risk estimates represent potential exposures to mercury and methyl mercury only.	May underestimate risk.
Lower range of risk estimates assume mercury is present as inorganic mercury (oral and dermal risk not quantified).	Most likely underestimates risk attributable to mercury.
Upper range of risk estimates assume mercury is present as mercuric chloride and methyl mercury.	Given that mercuric chloride is not likely present based on geochemical conditions that do not support its formation, the use of mercuric chloride as a surrogate adds uncertainty about potential risk to an exposed population.

2. The Baseline Ecological Risk Assessment (BERA)

Due to the heavily industrialized setting of the Former Chlorine Plant Area, and given that the area is predominantly paved, on-site exposure to ecological receptors in the Former Chlorine Plant Area is minimal. As a result, an ecological risk evaluation was not performed for the on-site portion of the Former Chlorine Plant Area. However, potential ecological receptors associated with the Roanoke River that may be exposed to mercury in sediment or in the surface water were evaluated by EPA during the RI activities on the Roanoke River, using data obtained during the Former Chlorine Plant RI as well as data obtained during the Roanoke River RI.. The following sections discuss the findings of the BERA relating to mercury contamination in the river near the Former Chlorine Plant.

a. Measurement Endpoints

There were a total of 9 assessment endpoints used to evaluate ecological risks in the Roanoke River BERA. The endpoints which are appropriate for the evaluation of mercury and methyl mercury in sediments and surface water are:

- Protection of Benthic Macroinvertebrates
- Protection of Insectivorous Birds
- Protection of Fish
- Protection of Omnivorous Birds
- Protection of Carnivorous/Piscivorous Birds
- Protection of Omnivorous Mammals

b. Effects Characterization

The approach taken to conduct the Roanoke River BERA was based on multiple lines of evidence to evaluate ecological risks (i.e., multiple measurement endpoints for each assessment endpoint, and data from mulitple sources such as site-specific toxicity data, bioaccumulation tests, general literature and food chain modeling). The effects shcaracterization for each endpoint was based on the measurement endpoints specified below:

- **Protection of Benthic Macroinvertebrates**: Risks to benthic macroinvertebrates were evaluated by comparison of river sediment concentrations to a range of benchmark values that represent a low-and mid-point of effects concentrations to aquatic organisms. These effects ranges were published by Long, et al. (1995) and are termed ER-L and ER-M respectively. The ER-L is the lower 10th percentile of the effects data, and the ER-M is the median, or 50th percentile of the effects data. Risks were also evaluated by a toxicity test using *Hyalella azteca*.

- **Protection of Insectivorous Birds**: Three types of data were collected for evaluation of exposure to this endpoint; chemical analysis of river sediments, chemical analysis of surface water, and a benthic macroinvertebrate bioaccumulation assay. The data were used in a food-chain model to evaluate risks to insectivorous birds following exposure to contaminated sediments, water and emergent insects. The barn swallow was selected as the representative insectivorous bird species.

- **Protection of Fish**: Three types of data were collected for evaluation of exposure to this endpoint: chemical analysis of river sediments, fish tissue, and surface water. Risks were evaluated by comparison of measured fish tissue concentrations to risk-based fish tissue concentrations published by Jarvinen and Ankley (1999), and concentrations published in the Environmental Residue-Effects Database (ERED) published by the US Army Corp of Engineers Waterways Experiments Station. Measured surface water concentrations were compared to the State of North Carolina Water Qulaity Standards, and No-Observed Effects Concentrations (NOECs) and Lowest-Observed Effects Concentrations (LOECs) obtained from Jarvin and Ankley (1999). The redear sunfish, bluegill, and largemouth bass were selected as representative species, representing at least two different trophic levels.

- **Protection of Omnivorous Birds**: Six types of data were collected for evaluation of exposure to this endpoint: chemical analysis of river sediments, fish, bivalves, and frogs, as well as a benthic macroinvertebrate bioaccumulation bioassay that provided tissue concentrations for *L. variegatus* (a surrogate for aquatic macroinvertebrates). The results of exposures to contaminants in these media were evaluated in a food-chain model. The wood duck was selected as the representative omnivorous bird species.

- **Protection of Carnivorous/Piscivorous Birds**: Exposure to this endpoint was evaluated using five types of data: chemical analysis of river sediments, surface water, fish, aquatic macroinvertebrates (from the *L. variegatus* bioaccumulation bioassay), and frogs. The results of exposures to contaminants in these media were evaluated in a food-chain model. The osprey and the green heron were selected as respresentative species for this assessment endpoint. The osprey captures fish from the surface of the water while in flight and is exposed to chemicals in the fish tissue, with a small contribution from drinking contaminated surface water. The green heron stalks its prey from shallow water and may be exposed to chemicals in prey as well as in surface water and sediments.

- **Protection of Omnivorous Mammals**: There were several types of data collected for evaluation of exposure to this endpoint, including chemical analysis of rever sediments, surface water and wetlands soils, a soil invertebrate and a benthic macroinvertebrate bioaccumulation bioassay, and tissue samples of *Corbicula* clams and several fish species. The results of exposures to contaminants in these media were evaluated in a food-chain model. The racoon and the river otter were selected as representative omnivorous mammal species.

c. Summary of Ecological Risk

Hazard Quotients and Remedial Goal Options were calculated for each assessment endpoint. Both the No-Observed Adverse Effects Level (NOAEL) and the Lowest-Observed Adverse Effects Level (LOAEL) are presented as a range of media concentrations that would result in no adverse effects to those that would result in low adverse effects.

The shallow sediments (0-6") are the only sediments considered available to ecological receptors. The shallow sediments collected in the Roanoke River in front of the Former Chlorine Plant have mercury concentrations ranging from 0.1 mg/kg to 0.77 mg/kg. The LOAL-based Remedial Goal Option for sediments at two locations for heron and river otter are slightly exceeded.

Table H-7 presents the summary of calculated LOAEL based Hazard Quotients and Remedial Goal Options for mercury which were calculated as part of the Ranoke River Investigation.

Table H-7
Hazard Quotients and RGOs for Selected Ecological Endpoints from the Roanoke River Study

Receptor Endpoint	Mean Hazard Quotient (HQ)	Maximum Hazard Quotient (HQ)	Remedial Goal Option-Sediment mg/kg
Benthic macroinvertebrates	2	11	nc*
Insectivorous Bird (Barn swallow)	0.39	0.82	0.97
Omnivorous Bird (Wood duck)	0.11	0.29	3.21
Carnivorous/ Piscivorous Bird (Heron)	0.7	**2.53**	0.37
Omnivorous Mammal (Otter)	0.61	**2.31**	0.42
Omnivorous Mammal (Raccoon)	0.19	0.59	45.3

* nc-not calculated

3. Basis for Action

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to human health, welfare, or the environment. Although the current risk measured in the human health risk assessment is low, there remains a significant possibility that a release of the large quantities of mercury contained in sub-surface soils in the Former Chlorine Plant Area will occur and that this release would result in an unacceptable risk to human health and the environment.

I. Remedial Action Objectives

Remedial Action Objectives (RAOs) for the Former Chlorine Plant Area were developed based on the requirements of the National Contingency Plan (40 CFR §300.430[e][2][i]), which defines remedial action objectives as a listing of the COCs and media of concern, potential exposure pathways and remediation goals. Specific RAOs were developed from a review of the results of site characterization activities, site-specific risk and fate and transport evaluations, and an initial review of ARARs.

The remedial action objectives are as follows:

- To maintain acceptable levels of potential risk to site-specific human receptors associated with exposure to mercury in soil and groundwater at the Former Chlorine Plant Area.
- To reduce groundwater levels of mercury in groundwater at a point of compliance to the NCMAC of 1.1 $\mu g/L$
- To prevent a release of the large quantities of mercury in subsurface soils to groundwater contaminating the Roanoke River.

These RAOs served as the basis for the design of Remedial Alternatives presented in the next section. Remedial Action Objectives which address contamination in the Roanoke River, including mercury contaminated sediments if appropriate, are being developed as part of the Roanoke River Operable Unit.

J. Description of Alternatives

1. Description of Remedy Components

Alternative 1-No Action

The No Action alternative is evaluated as a baseline option for comparison to other alternatives. Under this alternative, no remedial actions will be performed at the site.

- Five Year Review Costs: $ 100,000.00
  Total Present Worth Costs: $ 215,785.00

Soils: The soils in the Former Chlorine Plant Area will remain in their present condition.

Groundwater: No active remediation or monitoring. Mercury in the groundwater will be subject to reduction in concentration by natural physical and biochemical processes, although not significantly.

Alternative 2- Cooling Tower Repair with Groundwater Compliance and Trend Monitoring

- Cooling Tower Repair, routine inspection
- Surface Cover Improvements
- River Bulkhead inspections/routine maintenance
- Groundwater compliance and trend monitoring
- Land Use Restrictions

- Capital Costs: $ 427,000.00
  Annual O&M Costs: $ 143,163.00
  Total PW Costs: $2,420,000.00
  Duration to Finish Construction: 10-12 months

Soils: The subsurface soils in the Former Chlorine Plant Area will remain in their present condition. Currently, all of the Former Chlorine Plant Area is covered with pavement or structures. However, there are small grassy areas around the edges of the area near the existing bulkhead where soil is present at the ground surface. This alternative includes covering these areas and maintaining the integrity of the existing cover, minimizing surface run-off to the Roanoke River.

Groundwater: This alternative reduces the mass flux of mercury in the groundwater through the repair of the leaks from the cooling towers. The NCDENR is requiring the repair of the cooling towers and end the discharge of cooling water to groundwater, regardless of any decisions associated with this ROD. This repair reduces the volume of water moving through the mercury containing soils below the Former Chlorine Plant and the modification of the flow path of the groundwater.

A groundwater monitoring network of approximately 31 wells will be installed and monitored in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules. The monitoring network will provide data needed to update the modeled hydrogeologic conditions under the Former Chlorine Plant Area. The mercury concentrations in the source area of the aquifer will me monitored, but it is estimated that groundwater concentrations will remain above the NCMAC of 1.1 µg/L in some locations within the building footprint for an excess of 1 million years.

Also included in this alternative are regular bulkhead inspections to evaluate and monitor the integrity of the existing bulkhead along the Roanoke River. These non-destructive, visual inspections would be conducted both above and below the water line, to the sediment surface. Routine maintenance of the bulkhead is included in this alternative.

Land use restrictions: The land use restrictions would preclude the potable use of groundwater from the shallow aquifer beneath the Former Chlorine Plant and mercury plume areas. Currently, a map is on file with the Martin County Register of Deeds that identifies the Former Chlorine Plant Area as an Inactive Hazardous Substance or Waste Disposal Site (NCD 991-278-540). To the extent necessary, this deed notice will be revised as a part of the remedial design to reflect the selected remedy, to meet the current North Carolina administrative process, and any additional requirements to maintain the integrity of the remedy and to limit exposure to soil and groundwater. The Land use restrictions will be defined during the Remedial Design, and the State will continue to enforce the required controls.

Alternative 3- Extended Flow Path and Groundwater Compliance and Trend Monitoring

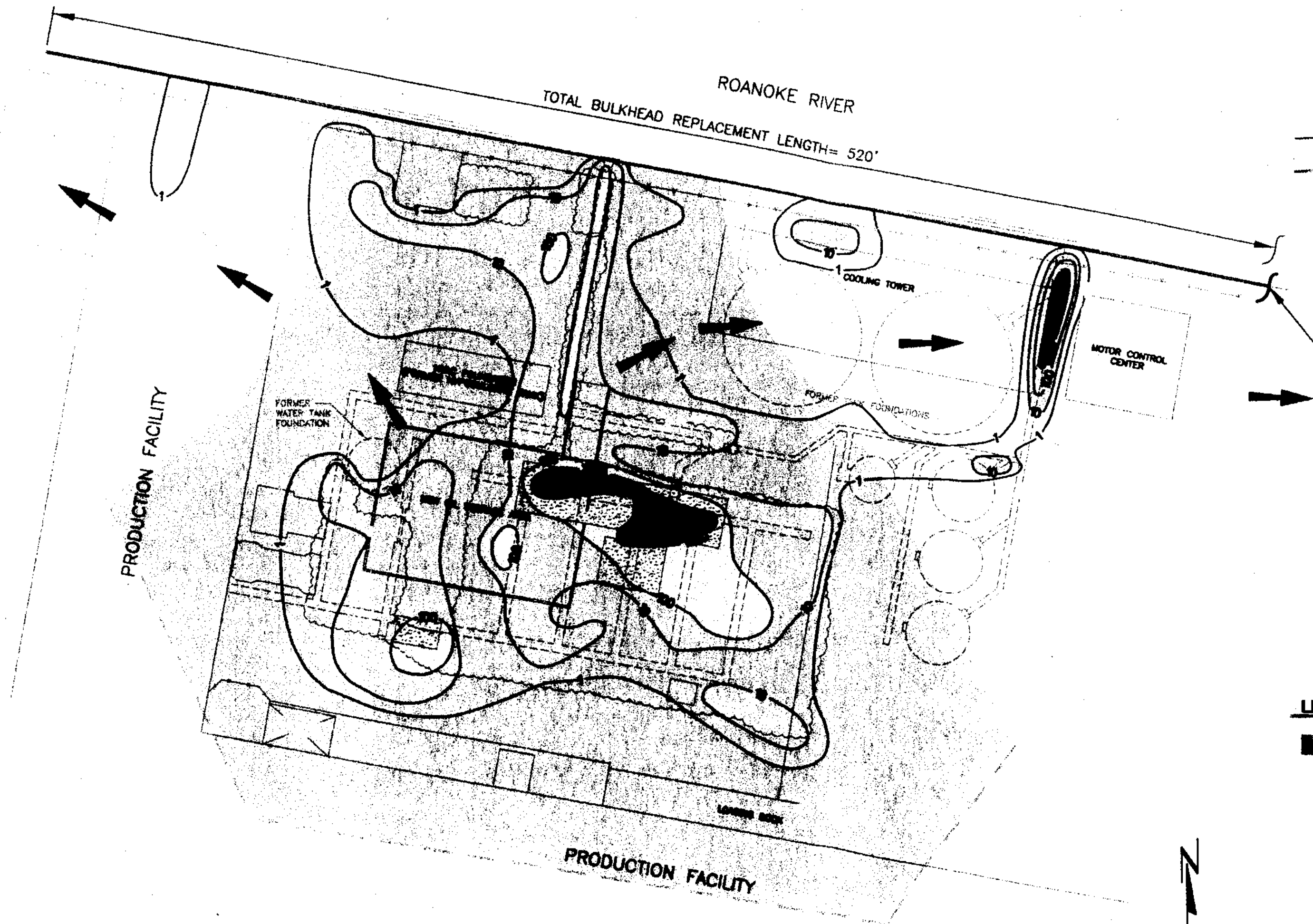
- Flow path modification through bulkhead wall improvements
- Cooling tower repair
- Surface cover improvements
- Groundwater compliance and trend monitoring
- Land use restrictions

- Capital Costs: $ 3,821,000.00
  Annual O&M Costs: $ 65,163.00
  Total PW Costs: $ 4,630,000.00

The soil and land use restriction components are the same as those described in Alternative 2.

Groundwater: In addition to the cooling tower repair and groundwater compliance and trend monitoring components described in Alternative 2, this alternative includes the installation of a vertical barrier wall system along the Roanoke River, downgradient of the source area. This barrier system would reduce the mass flux of mercury in groundwater leaving the Former Chlorine Plant Area and discharging to the Roanoke River. The wall would be placed to a depth of approximately 45 feet below ground surface and would tie into the low permeability clay aquitard. The length of this wall is expected to cover approximately 520 feet of river frontage, approximately 2.5 times longer than the length of the Former Chlorine Plant footprint **(Figure J-1)**. The barrier would consist of sealed sheet piling which will retard groundwater flow directly to the Roanoke River, with a design hydraulic conductivity of approximately 5.0 X 10^{-8} cm/s, compared to the estimated hydraulic conductivity of the existing sheet pile bulkhead of approximately 1 X 10^{-5} cm/s or more. The new bulkhead would be connected to the existing bulkhead through a series of tie backs. The installation of this barrier wall would lengthen the flow path from the source area to the river as the groundwater would have to flow around the barrier rather than directly to the river though the existing unsealed wall.

The flow path lengthening will increase the mass of soil (and therefore increase potential adsorptive surface area) that the groundwater will pass through, which will result in a greater amount of mercury mass adsorbed over time. However, because of the continuing source of mercury, the finite adsorptive capacity of the soil will in time be exceeded and the mercury flux to the river will ultimately return to the mass levels estimated for Alternative 2. As a result of the lengthened flow path a greater volume of aquifer will contain groundwater in excess of the NCAC 2L standard.



LEGEND

APPROXIMATE LOCATION OF FORMER EQUIPMENT AND SUBSURFACE UTILITIES

EXISTING EQUIPMENT

APPROXIMATE EXTENT OF 4-FOOT DEEP SOIL EXCAVATION (HLA, 1992)

BURIED CONCRETE SLABS

— 10 — ESTIMATED EXTENT OF TOTAL MERCURY, ISOCONCENTRATION IN SOIL (mg/kg)

PROPOSED REPLACEMENT SEAWALL (SEALED)

ANTICIPATED GROUNDWATER FLOW (ASSUMES COOLING TOWER LEAKS ARE FIXED)

APPROXIMATE EXTENT OF DISSOLVED MERCURY ≥ 1 μg/L IN GROUNDWATER

FENCE LINE

LEGEND (CONT.)

TOTAL MERCURY CONCENTRATIONS IN SOIL ≥1000mg/kg

TOTAL MERCURY CONCENTRATIONS IN SOIL ≥100mg/kg

TOTAL MERCURY CONCENTRATIONS IN SOIL ≥10mg/kg

NOTES

1. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.
2. ESTIMATED MERCURY ISOCONCENTRATIONS IN SUBSURFACE SOIL DETERMINED FROM FIGURE 5-1A OF THE REMEDIAL INVESTIGATION REPORT (RMT 2000).
3. SUBSURFACE SOIL MERCURY CONCENTRATIONS PRESENTED FOR 8 TO 0 FT. NGVD29. (0-8 FT BGS)
4. GROUND SURFACE ELEVATION APPROXIMATELY 8 FEET NGVD29.

0 40' 80'

SCALE: 1"= 40'

PROJECT:	FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA	
SHEET TITLE:	ALTERNATIVE 3 - EXTENDED FLOW PATH AND GROUNDWATER COMPLIANCE AND TREND MONITORING	
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 05100.63
CHECKED BY: BSJ	1"=40'	FILE NO. 51006301.DWG
APPROVED BY: SAM	DATE PRINTED: JUN 24 2003	
DATE: JUNE 2003		

RMT INC.

Figure J-1

PLOT DATA
Drawing Name: ...5100\63\border.dwg
Operator Name:
Scale: 1"=1
Dwg Size: 44817 Bytes
Plot Date: Thursday, May 29, 2...
Plot Time: 11:04:42 AM
Attached Xref's: No xref's attached.
Attached Image's: No images attached

Alternative 4-Containment with Groundwater Compliance and Trend Monitoring

- *In-situ* Barrier wall around Former Chlorine Plant building footprint
- Shallow "target area" soil excavation
- Groundwater compliance and trend monitoring
- Cooling Tower Repair
- Surface cap containment system
- Land use restrictions

- Capital Costs: $ 5,010,000.00
  Annual O&M Costs: $ 49,465.00
  Total PW Costs: $ 5,624,000.00

Soil: This alternative consists of the installation of a vertical barrier wall system around the source area, and "targeted" excavation of soil from the Central U-drain area and the Eastern U-drain area. Various types of barrier walls can be utilized for the containment of mercury contaminated soils in the Former Chlorine Plant building footprint. For purposes of cost estimating in the FS, a sealed sheet pile barrier wall was evaluated. The final material will be determined during remedial design but shall meet the specifications that follow.

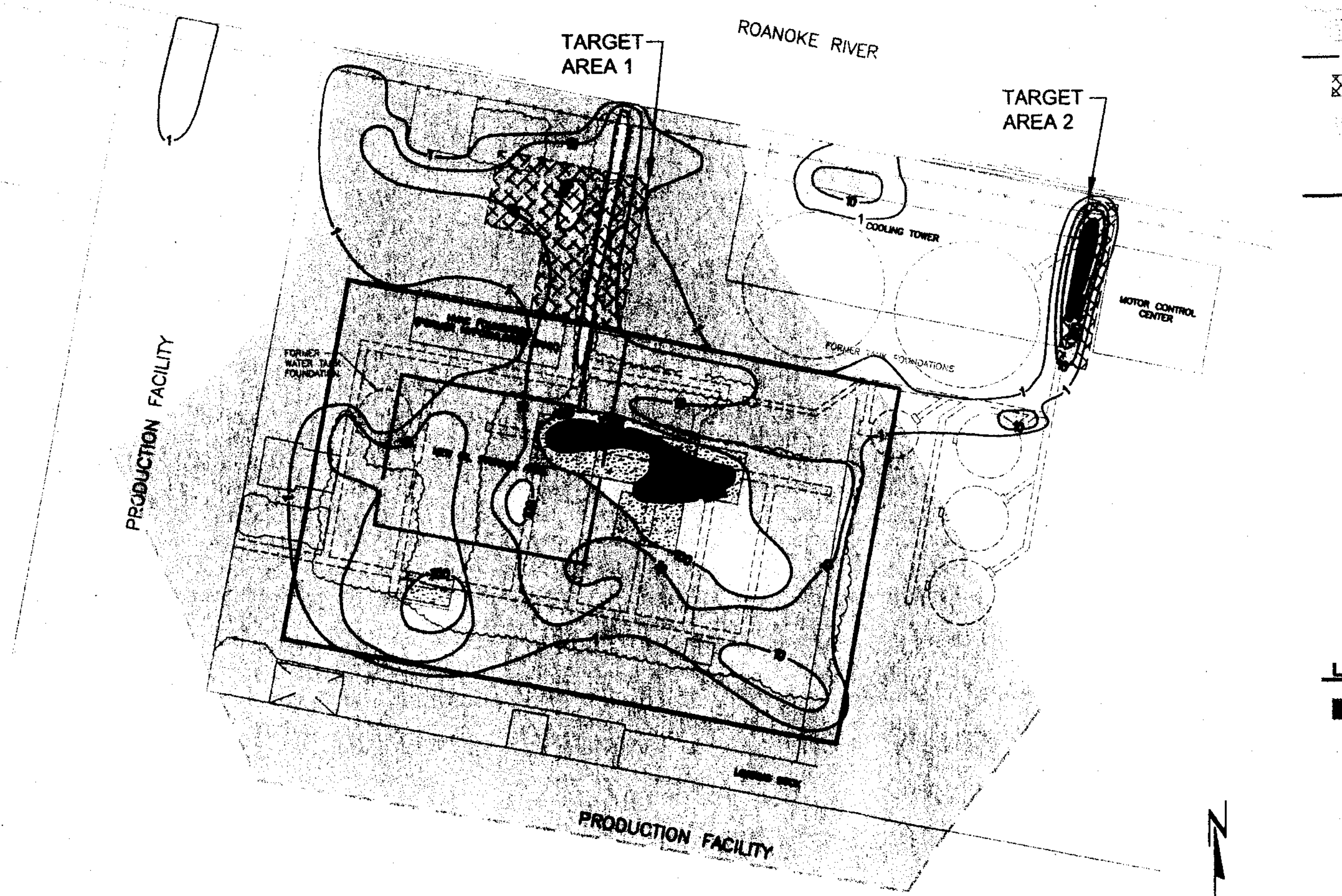
The wall enclosing the source area will consist of a sealed/low permeability barrier, with an estimated permeability of 5.0×10^{-8} cm/s. The wall will be installed to approximately 45 feet below ground surface, tying into the low-permeability clay aquitard beneath the site. The conceptual wall has a total length of 610 feet, and would enclose an area of approximately 23,000 square feet and a volume of approximately 38,000 cubic yards of soil **(Figure J-2)**. Approximately 7,200 pounds of mercury (or 96 percent of the estimated total mass of mercury) will be enclosed by the barrier.

Also included in this alternative as shown on **Figure J-2** are two "target area" excavations. These target areas include excavation of both saturated and unsaturated soil. The excavations will extend to the practicable horizon and vertical limits near the former hypochlorite tank/central U-drain (Area 1) and along the Eastern U-drain (Area 2). The excavations will removed surface soil and subsurface soil to a mercury level of 20 mg/kg. Structural sheet piling will be utilized for excavation stabilization and shoring. It is assumed that interlocking sheet piling will be driven to 25 feet around Area 1 and 20 feet around Area 2. No de-watering of soil is anticipated. Solidification of excavated, saturated soil will be performed in constructed bunkers with the addition of a solidification agent such as fly ash. Area 1 has a surface area of approximately 2,000 square feet. At an average depth of 10 feet, excavation would remove approximately 750 cubic yards of soil. About 80 pounds of mercury would be removed from Area 1 (approximately 1 percent of the estimated total mass of mercury). Area 2 measures approximately 10 feet by 55 feet, and at an average depth of 8 feet, a total of 150 cubic yards of soil would be excavated, containing approximately 230 pounds of mercury (about 3 percent of the total mass of mercury).

The Toxicity Characteristic Leaching Procedure (TCLP) limit for mercury (40 CFR 261.24) is 0.2 mg/L. The TCLP values for the shallow soil samples from the Former Chlorine Plant have historically not exceeded 0.09 mg/L, even in soil with total mercury concentrations as high as 2,900 mg/kg. If TCLP results are above 0.2 mg/L and total mercury concentrations are greater than or equal to 260 mg/kg (40 CFR 268.40), then the material must be retorted (or equivalent process) to recover and recycle the mercury as per the Universal Treatment Standard (UTS). For purposes of cost estimating it was assumed that materials from Area 1 would be nonhazardous as defined by the TCLP. In Area 2, it was assumed that 50 percent of the excavated material would be nonhazardous and 50 percent would be hazardous. The nonhazardous materials would be disposed of at the facilities nonhazardous landfill, or off-site at a nonhazardous landfill, and the hazardous material will be sent to an off-site retort facility for treatment prior to disposal. The excavations will be backfilled with clean fill material and covered. The surface cap containment system will require the replacement of pavement over areas disturbed by the barrier wall installation, the excavations, and the currently un-covered surface soil adjacent to the river.

Groundwater: Mercury concentrations in groundwater immediately outside of the containment area are assumed to be 2.3 $\mu g/L$. Concentrations of mercury in the groundwater outside of the containment area are estimated to fall below the NCMAC of 1.1 $\mu g/L$ in 4 years. However, these flushing calculations did not take into account the sorption of mercury to soil. If mercury sorption to soils is included, with a low retardation factor of 10 for example, it would require 40 years to reach the NCMAC. To assess the mercury concentration trends in groundwater, this alternative includes the implementation of a groundwater compliance and trend monitoring program consisting of 12 monitoring wells sampled over 30 years in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules.

The land use restrictions are the same as those described in Alternative 2.



LEGEND

- APPROXIMATE LOCATION OF FORMER EQUIPMENT AND SUBSURFACE UTILITIES
- EXISTING EQUIPMENT
- APPROXIMATE EXTENT OF 4-FOOT DEEP SOIL EXCAVATION (HLA, 1992)
- BURIED CONCRETE SLABS
- 10 — ESTIMATED EXTENT OF TOTAL MERCURY, ISOCONCENTRATION IN SOIL (mg/kg)
- PROPOSED TARGET AREA EXCAVATION LIMITS
- APPROXIMATE EXTENT OF DISSOLVED MERCURY ≥ 1 μg/L IN GROUNDWATER
- FENCE LINE
- PROPOSED BARRIER WALL ALIGNMENT

LEGEND (CONT.)

- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥1000mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥100mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥10mg/kg

0 40' 80'
SCALE: 1"=40'

NOTES

1. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.
2. ESTIMATED MERCURY ISOCONCENTRATIONS IN SUBSURFACE SOIL DETERMINED FROM FIGURE 5-1A OF THE REMEDIAL INVESTIGATION REPORT (RMT 2000).
3. SUBSURFACE SOIL MERCURY CONCENTRATIONS PRESENTED FOR 8 TO 0 FT. NGVD29. (0-8 FT BGS)
4. GROUND SURFACE ELEVATION APPROXIMATELY 8 FEET NGVD29.

PROJECT:	FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA	
SHEET TITLE:	ALTERNATIVE 4 - CONTAINMENT WITH GROUNDWATER COMPLIANCE AND TREND MONITORING	
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 05100.63
CHECKED BY: BSJ	1"=40'	FILE NO. 51006302.DWG
APPROVED BY: SAM	DATE PRINTED:	
DATE: JUNE 2003	JUN 24 2003	Figure J-2

RMT INC.

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Plot Time: 11:04:42 AM
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Attached Image's: No images attached

Alternative5- Funnel and Gate System

- *In-situ* Funnel and Gate Treatment system
- Shallow "target area" excavations
- Surface Cover
- Cooling Tower Repair
- Groundwater compliance and trend monitoring
- Land use restrictions

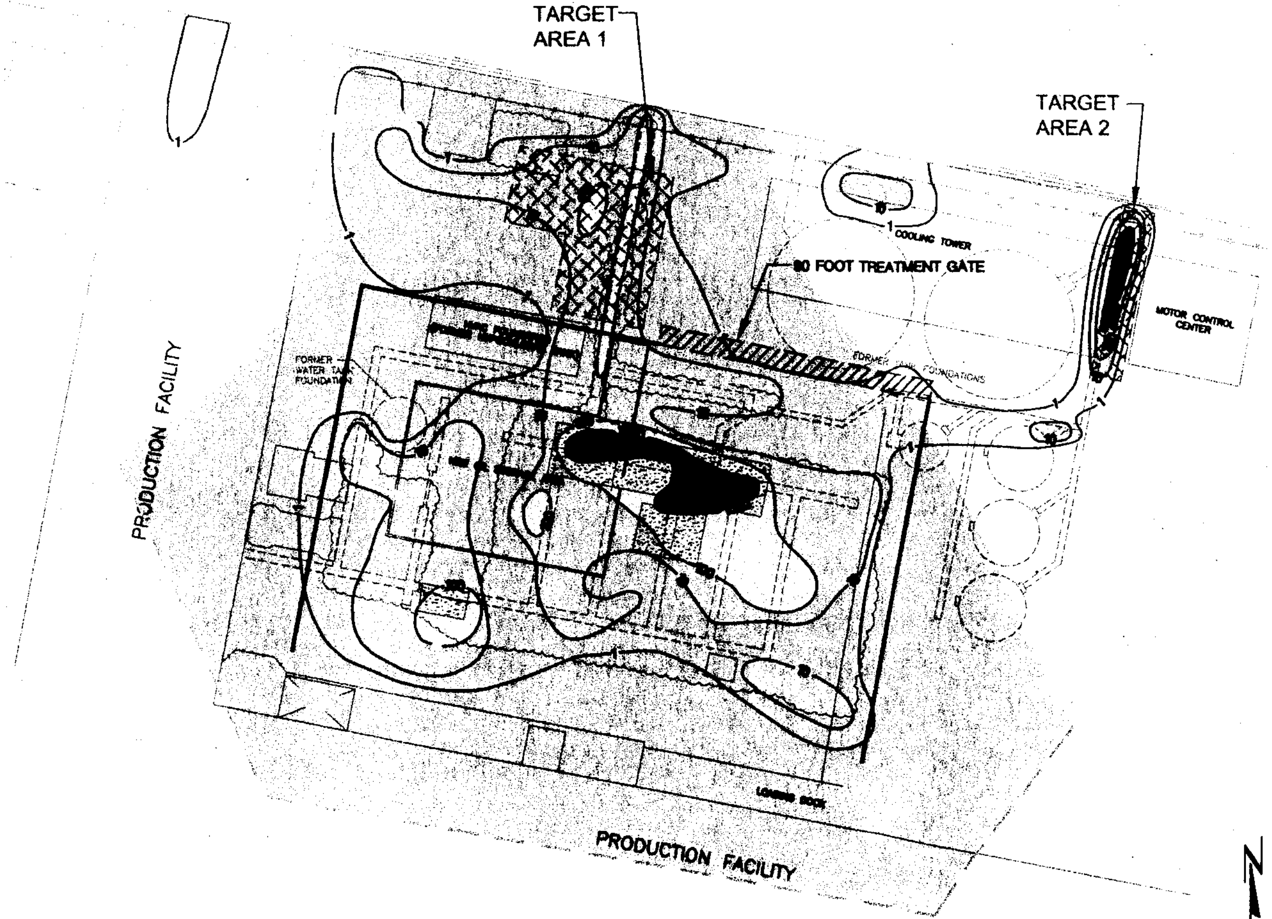
- Capital Costs: $ 6,161,000.00
  Annual O&M Costs: $ 58,175.00
  Total PW Costs: $ 6,883,000.00

Soils: This alternative contains the same excavations of Areas 1 and 2 described in Alternative 4. The surface cover replacement is also the same. The land use restrictions are the same as those described in Alternative 2.

Groundwater: This alternative funnels impacted groundwater through an *in-situ* treatment gate between the impacted saturated soil beneath the Former Chlorine Plant footprint and the Roanoke River. A low permeability vertical barrier would be used to construct the *in-situ* funnel and activated carbon will form the reactive media in the center of the funnel. This reactive media in the treatment gate would remove aqueous mercury from groundwater that passes beneath the Former Chlorine Plant. A treatability study was performed for this site. The results have been used to estimate the effectiveness of the overall alternative. The funnel and gate system has been conceptually sized and oriented to direct approximately 97 percent of the groundwater that enters the funnel system through the treatment gate. The treatment gate media would be installed from near surface to approximately 40 feet below the ground surface, where the low-permeability clay aquitard is encountered. The engineered funnel would consist of joint-sealed steel sheet piling installed to approximately 45 feet. **Figure J-3** shows the details of the wall alignment and **Figure J-4** shows the conceptual treatment gate.

The ground surface length of joint-sealed sheet piling associated with the funnel totals 340 feet. The hydraulic conductivity will be 5.0×10^{-8} cm/s. The hydraulic conductivity of the aquifer is approximately 6.0×10^{-4} cm/s (upper), 2.0×10^{-3} cm/s (middle) and 6.0×10^{-3} cm/s (lower); and the hydraulic conductivity of the mixed reactive media is expected to be no less than 6.0×10^{-3}. Given the differences in hydraulic conductivity, it is expected that the sealed sheet piling on either side of the reactive media will serve as a funnel that directs groundwater flow through the reactive gate. The 90-foot-long treatment zone within the gate would be 6 feet wide and 36 feet high, and would consist of a 50/50 mixture by volume of granular activated carbon and sand. The 50/50 mixture was chosen to enhance flow and constructability. Numerical simulations determined flow through the gate to be 98 cubic feet per day (0.8 gpm). The calculated average effluent on the other side of the gate is 0.0000129 μg/L after 30 years of groundwater flow, representing greater than 99.9% removal efficiency. The overall mass flux reduction was calculated to be 97.1%.

This alternative would also require the implementation of an integrated treatment performance and groundwater compliance monitoring program to evaluate *in-situ* treatment effectiveness, plume stability, plume movement and the effectiveness of natural processes to reduce mercury concentrations in groundwater. The monitoring network would include the 12 existing wells and 15 new wells, and monitoring would continue for 30 years, in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules.



LEGEND

- APPROXIMATE LOCATION OF FORMER EQUIPMENT AND SUBSURFACE UTILITIES
- EXISTING EQUIPMENT
- APPROXIMATE EXTENT OF 4-FOOT DEEP SOIL EXCAVATION (HLA, 1992)
- BURIED CONCRETE SLABS
- 10 — ESTIMATED EXTENT OF TOTAL MERCURY, ISOCONCENTRATION IN SOIL (mg/kg)
- PROPOSED TREATMENT GATE ALIGNMENT
- APPROXIMATE EXTENT OF DISSOLVED MERCURY ≥ 1 µg/L IN GROUNDWATER
- FENCE LINE
- PROPOSED SHEET PILE FUNNEL ALIGNMENT
- PROPOSED TARGET AREA EXCAVATION LIMITS

LEGEND (CONT.)

- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥1000mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥100mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥10mg/kg

N

0 40' 80'

SCALE: 1"=40'

NOTES

1. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.
2. ESTIMATED MERCURY ISOCONCENTRATIONS IN SUBSURFACE SOIL DETERMINED FROM FIGURE 5-1A OF THE REMEDIAL INVESTIGATION REPORT (RMT 2000).
3. SUBSURFACE SOIL MERCURY CONCENTRATIONS PRESENTED FOR 8 TO 0 FT. NGVD29. (0-8 FT BGS)
4. GROUND SURFACE ELEVATION APPROXIMATELY 8 FEET NGVD29.

PROJECT: **FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA**

SHEET TITLE: **ALTERNATIVE 5 - FUNNEL AND GATE SYSTEM**

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APPROVED BY: SAM	DATE PRINTED: JUN 24 2003	Figure J-3
DATE: JUNE 2003		

RMT INC.

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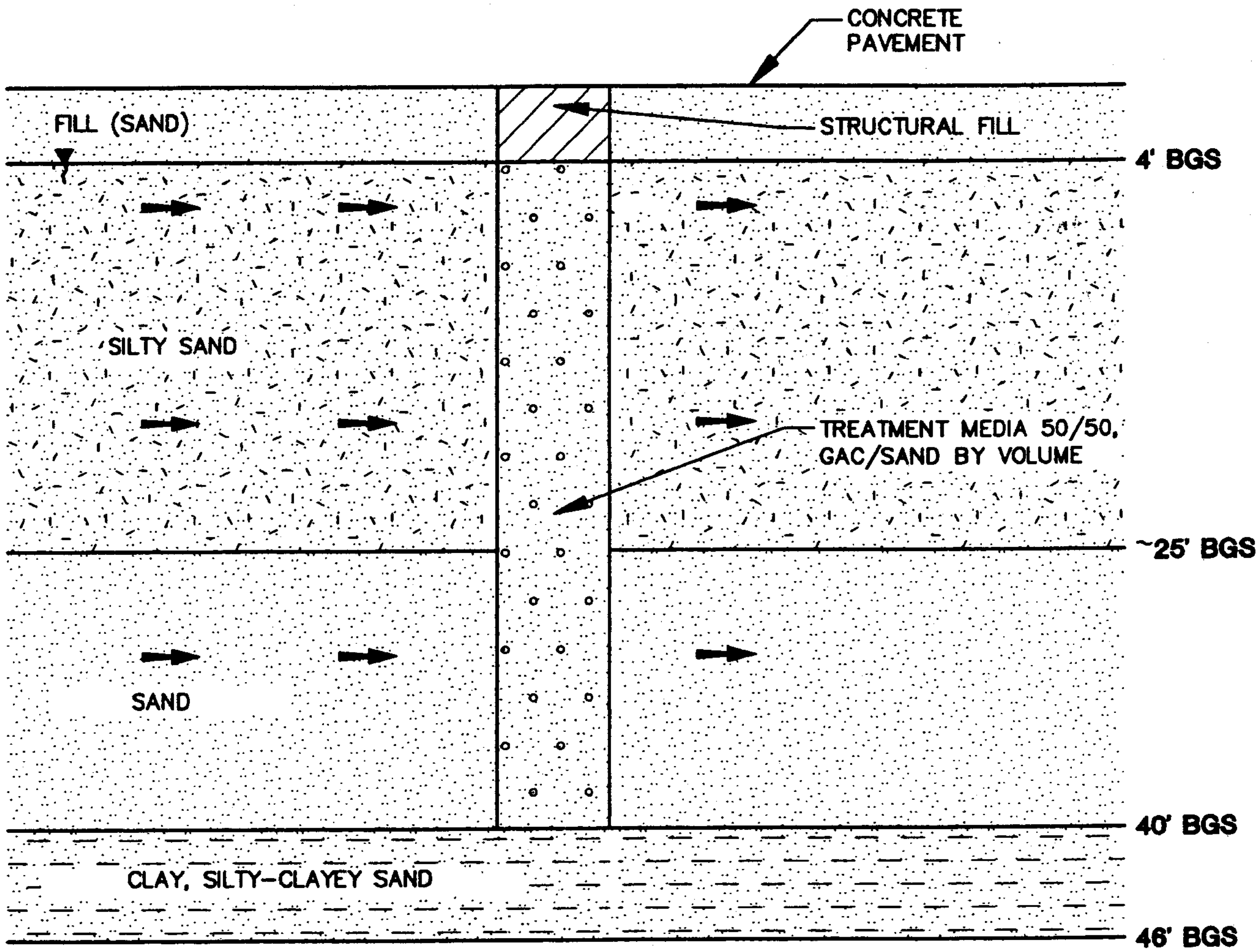
Attached Image's: No images attached



LEGEND

EXAMPLE GROUNDWATER FLOW
(NOTE: GROUNDWATER CAN FLOW EITHER DIRECTION THROUGH THE TREATMENT GATE)

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RMT INC.

FEASIBILITY STUDY
WEYERHAEUSER CO.
MARTIN COUNTY, NORTH CAROLINA

ALTERNATIVE 5 -
CONCEPTUAL TREATMENT GATE
CROSS SECTION

DRAWN BY:	DEFOEJ
APPROVED BY:	SAM
PROJECT NO.	
FILE NO.	
DATE:	

Figure J-4

Alternative 6- Groundwater Extraction and Treatment

- Groundwater Extraction
- Groundwater Treatment
- Shallow "target area" excavations
- Surface Cover
- Cooling Tower Repair
- Groundwater compliance and trend monitoring
- Land use restrictions

- Capital Costs: $ 2,957,000.00
  Annual O&M Costs: $ 373,055.00
  Total PW Costs: $ 7,586,000.00

Soil: Included in this alternative is the target excavation of Area 2 only. Area 1 is not included because it is contained within the hydraulic containment area described below. The cover replacement and land use restrictions are the same as previously described.

Groundwater Extraction: Mercury contaminated groundwater would be removed from the shallow aquifer below the Former Chlorine Plant Area through three groundwater extraction wells and conveyed to a treatment system by means of underground forcemains. The conceptual design of the extraction and conveyance network are shown on **Figure J-5**. The wells will extend to the top of the low-permeability clay unit (approximately 40 feet bgs) and will have a screened interval of 35 feet. The extraction wells are expected to have a combined flow rate between 7.5 and 15 gpm. The resulting capture zone is shown in **Figure J-5**. The estimated composite influent mercury concentrations entering the treatment system are expected to be between 0.30 and 0.76 $\mu g/L$. Given the mass of mercury present below the Former Chlorine Plant Area, the pumping will have to continue for 100,000's of years before the NCMAC is achieved.

Groundwater Treatment:

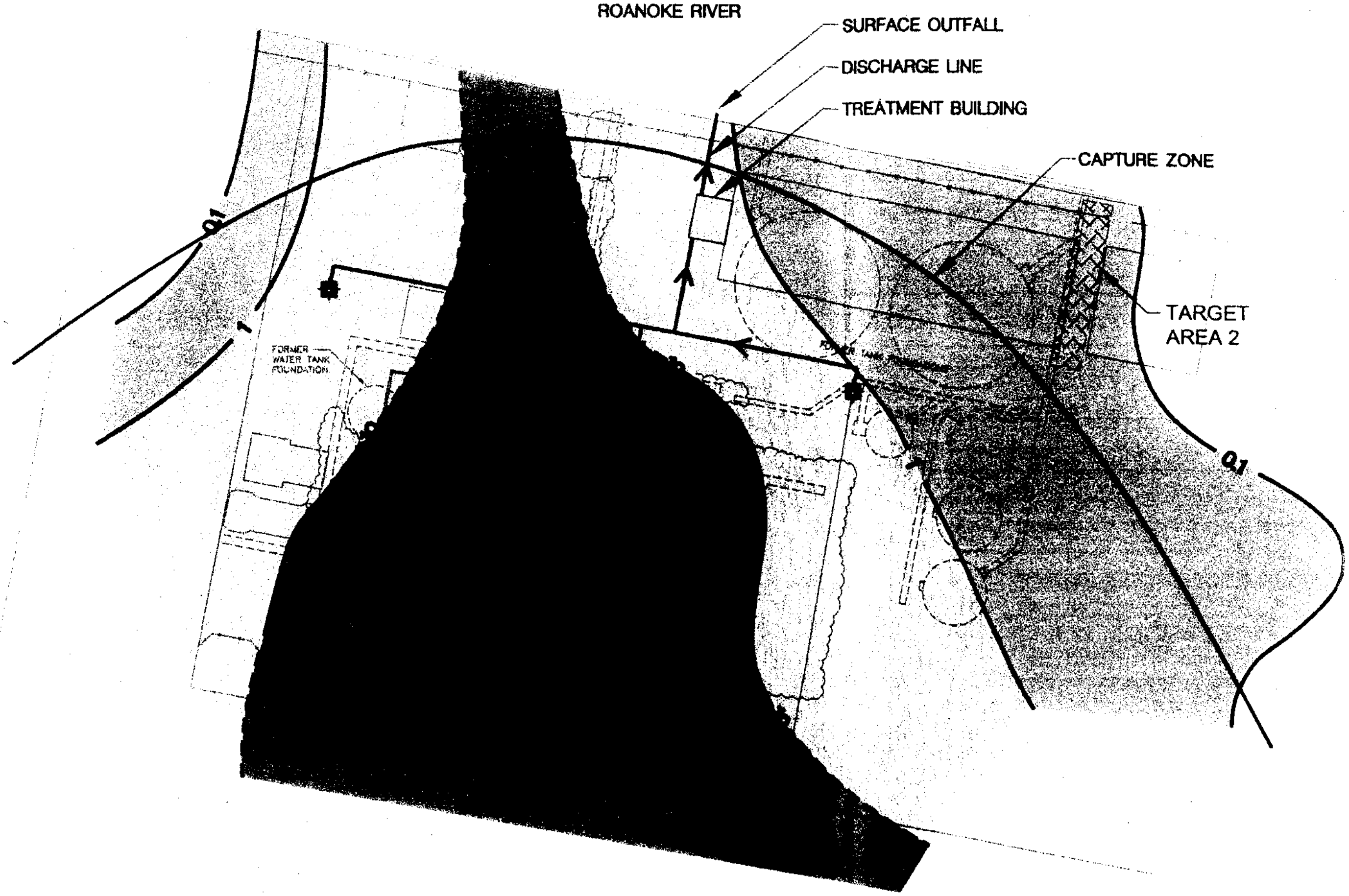
Flocculation/Precipitation pretreatment: Because of the specific groundwater chemistry, it is anticipated that the extracted groundwater stream will require pretreatment. The conceptual design consists of reactor and clarifier modules. Air or chemicals would be injected into the groundwater in the reactor module to drive ferrous iron into the ferric state, initiating precipitation to remove the high levels of iron in the groundwater. Then, a flocculent polymer would be injected as the water is transferred to the clarifier module. The clarifier module is used to remove and collect the precipitated solids. Potentially, a significant amount of mercury could be incorporated into the iron matrix and removed during the flocculation/precipitation process. As a conceptual design estimate, a 50 percent mercury removal is assumed during the pretreatment process. Sludge generated during the solids removal process would be pressed and disposed of in the facility's on site nonhazardous waste landfill. Approximately 5 cubic feet of sludge cake would be generated per day.

Liquid-phase carbon adsorption treatment train: Following the pretreatment step, carbon adsorption would be used to treat the effluent from the clarifier module. It is assumed that the removal efficiency of the Granular Activated Carbon (GAC) would be 50 percent. Based on the treatability study it is estimated that between 3,000 and 6,000 pounds per year of carbon will be needed. The treatment system would consist of two parallel trains of two 1,000-pound carbon units to allow for continuous operation. It was assumed for cost estimating purposes that the spent carbon would be nonhazardous following testing, and would disposed of in the facility's on-site landfill.

Ion exchange resin: After exiting the carbon treatment train, the water stream would be passed through treatment vessels containing ion exchange resin, and, if require, through a post-filtration process to remove any additionally-precipitated solids or resin. A 75 percent mercury removal efficiency is assumed for this part of the treatment system. Vessel replacement may be necessary as often as once per year. Pending waste concentration and characteristic testing, the spent resin would either be disposed of as a hazardous waste, treated at a retort facility and disposed as a hazardous waste, or as a nonhazardous solid waste in the facility's on-site landfill.

Discharge compliance: Based on the information presented and the treatability study work performed, the mercury concentrations in the effluent stream are expected to be $<0.1\ \mu g/L$ but likely higher than $0.012\ \mu g/L$, the current North Carolina surface water quality standard for mercury.

Groundwater compliance and trend monitoring will also be performed under this alternative in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules. It is estimated that 13 of the existing monitoring wells will be sampled along with 4 new wells. In addition, each extraction well's concentration and flow, treatment system influent, intermediate (between carbon or ion exchange vessels) and treatment system effluent will be sampled monthly.



LEGEND

0.1 — CONCENTRATION OF TOTAL MERCURY AT THE WATER TABLE (μg/L) @ 4 FT. ELEVATION (NGVD 29) (DASHED WHERE INFERRED)

CONCEPTUAL DESIGN EXTRACTION WELL LOCATION

TOTAL MERCURY IN SHALLOW GROUNDWATER

- 0.1 TO 1 μg/L
- 1 TO 10 μg/L
- >10 μg/L

FENCE LINE

PROPOSED TARGET AREA EXCAVATION LIMITS

0 40' 80'

SCALE: 1"= 40'

NOTES

1. GROUND SURFACE ELEVATION APPROXIMATELY 8FT. (NGVD29).
2. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.

PROJECT:	**FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA**	
SHEET TITLE:	**ALTERNATIVE 6 - GROUNDWATER EXTRACTION AND TREATMENT**	
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 05100.63
CHECKED BY: BSJ	1"=40'	FILE NO. 51006305.DWG
APPROVED BY: SAM	DATE PRINTED: JUN 24 2003	Figure J-5
DATE: JUNE 2003		

RMT INC.

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Plot Time: 11:04:42 AM
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Attached Image's: No images attached

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Alternative 7- Mass Excavation

- Excavation of surface and subsurface soil
- Surface cover replacement
- Cooling Tower Repair
- Groundwater compliance and trend monitoring
- Land use restrictions

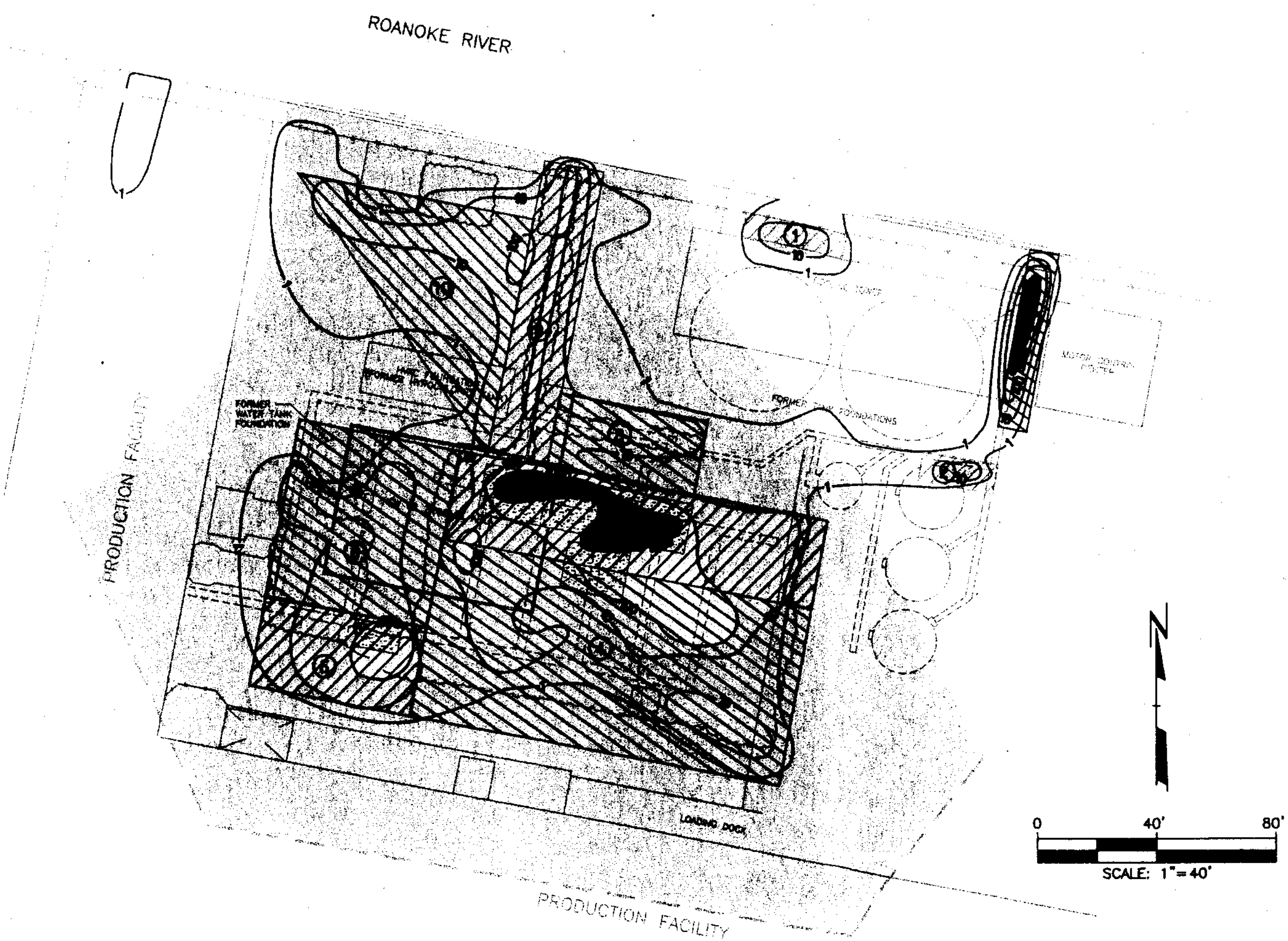
- Capital Costs: $ 17,005,000.00
  Annual O&M Costs: $ 49,465.00
  Total PW Costs: $ 17,619,000.00

Soil: This alternative primarily consists of source area excavation and off-site disposal of excavated mercury-bearing soil. **Figure J-6** presents the conceptual plan of the excavation alternative. The excavation would have to be performed in phases to allow manufacturing operations to continue and to allow various target depths to be structurally supported with sheet-piling engineering controls. A total of 10 excavation phases ranging from 10 to 40 feet below ground surface in depth are presented on **Figure J-6**. A majority of the excavations are expected to be performed in the wet, but dewatering is assumed for some deeper excavation phases. The collected groundwater from the dewatering, as well as decant water from saturated soil would require treatment prior to any discharge.

The excavation area is approximately 24,000 square feet, and the total volume of soil to be excavated is approximately 16,000 cubic yards. For cost estimating purposes, it was estimated that approximately 1,050 cubic yards of soil having mercury concentration of 260 mg/kg or above would be treated as a hazardous waste and require off-site management at a retort facility. The remainder of the nonhazardous soil would be placed in the facility's on-site landfill, permitted by NCDENR. As with Alternative 3, the soil will be amended with fly ash when necessary for solidification.

Upon cell completion and confirmation sampling at each excavation, the cell would be backfilled with clean fill, the fill would be compacted in multiple lifts, and the excavation are would ultimately be paved to match the existing facility ground surface.

Groundwater: This alternative involves leaving in-place mercury contaminated groundwater above the NCMAC of 1.1 $\mu g/L$ in the areas beyond the limits of the excavation. It is estimated that between 2 and 20 years will be required for natural processes to reduce mercury levels in groundwater to below the standard. A total of 12 wells would be used to monitor groundwater for compliance and contaminant reduction in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules.



LEGEND

- APPROXIMATE LOCATION OF FORMER EQUIPMENT AND SUBSURFACE UTILITIES
- EXISTING EQUIPMENT
- APPROXIMATE EXTENT OF 4-FOOT DEEP SOIL EXCAVATION (HLA, 1992)
- BURIED CONCRETE SLABS
- 10 — ESTIMATED EXTENT OF TOTAL MERCURY, ISOCONCENTRATION IN SOIL (mg/kg)
- INTERNALLY BRACED DEEP EXCAVATION AREA (UP TO 40' bgs)
- INTERNALLY BRACED EXCAVATION AREA (UP TO 20' bgs)
- CANTILEVERED EXCAVATION AREA (UP TO 12' bgs)
- SHALLOW TARGET AREA EXCAVATION (UP TO 8' bgs)
- 4 — EXCAVATION CELL AREA
- APPROXIMATE EXTENT OF DISSOLVED Hg ≥ 1 μg/L IN GROUNDWATER
- TOTAL MERCURY CONCENTRACTIONS IN SOIL ≥1000mg/kg
- TOTAL MERCURY CONCENTRACTIONS IN SOIL ≥100mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥10mg/kg
- FENCE LINE

NOTES

1. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.
2. ESTIMATED MERCURY ISOCONCENTRATIONS IN SUBSURFACE SOIL DETERMINED FROM FIGURE 5-1A OF THE REMEDIAL INVESTIGATION REPORT (RMT 2000).
3. SUBSURFACE SOIL MERCURY CONCENTRATIONS PRESENTED FOR 8 TO 0 FT. NGVD29. (0-8 FT BGS)
4. GROUND SURFACE ELEVATION APPROXIMATELY 8 FEET NGVD29.

PROJECT: **FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA**

SHEET TITLE: **ALTERNATIVE 7 - MASS EXCAVATION**

DRAWN BY: DEFOEJ	SCALE: 1"=40'	PROJ. NO. 05100.63
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DATE: JUNE 2003		

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Figure J-6

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2. Common Elements, Distinguishing Features and Expected Outcomes

With the exception of the no action alternative, the components of each alternative are designed to be protective of human health and the environment. As such, all of the active alternatives incorporate components to maintain land use controls needed to control direst contact exposure pathways and will provide long-term protection of human health. For all alternatives, except Alternative 7, mass excavation, the mass of mercury will remain in place. To limit future impacts and improve the long term reliability of those alternatives where mercury is left on site, various containment approaches and/or inspections are incorporated into the remedial alternatives.

The environmental impacts associated with continued migration of mercury to the groundwater with ultimate discharge to the Roanoke River will be controlled to differing levels in each alternative. Each alternative has some uncertainty regarding long-term adequacy, reliability and permanence. Therefore, all of the alternatives, except no-action, will include groundwater monitoring to assess the long-term effectiveness of mass removal, mass containment, reduction through natural processes and/or groundwater treatment, in accordance with the North Carolina administrative process for establishing compliance monitoring locations under the NCAC 2L rules.

None of the alternatives directly reduce the toxicity of mercury. However, by removing mercury-bearing soil and by removing mercury form groundwater, the potential toxicity of the media are reduced. There are significant differences between the alternatives with regard to mercury mobility as measured by mass flux reduction to the Roanoke River.

A general qualitative comparative summary for each alternative for the broad criteria of compliance with ARARs, effectiveness, implementability and cost is presented in **Table J-1**.

Table J-1
Comparative Evaluation Summary of Qualitative Assessment
Former Chlorine Plant

ALTERNATIVE NO.	ALTERNATIVE DESCRIPTION	GROUNDWATER PLUME ARAR COMPLIANCE[1]	TREATMENT AND/OR REMOVAL COMPONENT	ESTIMATED MERCURY MASS FLUX[3] GRAMS/YEAR	PERCENT REDUCTION (%)	SOURCE REMOVAL TIME (years)	PLUME REMOVAL TIME (years)	RELATIVE IMPLEMENTABILITY	COST ($ MILLIONS)[4]
1	No Action	No	No	5.4	N/A	600,000	NA	Easy	$0
2	Cooling Tower Repair and Groundwater Compliance and Trend Monitoring	Yes	No	3.2	41	1,000,000	NA	Easy	$2,420,000
3	Extended Flow Path and Groundwater Compliance and Trend Monitoring	Yes	No	0.91	83	3,600,000	. NA	Moderate	$4,630,000
4	Containment with Groundwater Compliance and Trend Monitoring	Yes	Yes	0.14	97	NA	4 to 40	Moderate	$5,624,000
5	Funnel and Gate System	Yes	Yes	0.32	94	1,000,000	3 to 30	Difficult	$6,883,000
6	Groundwater Extraction and Treatment	Yes[2]	Yes	4.6 to 4.8	86 to 89	280,000	2 to 20	Moderate/Difficult**	$7,586,000
7	Mass Excavation	Yes	Yes	<0.054	>99	NA	2 to 20	Difficult	$17,619,000

Notes:
(1) Groundwater in the vicinity of the Former Chlorine Plant currently exceeds the numerical NCMAC for mercury in groundwater. However, the 2L standard provides administrative provisions to identify points of compliance or establish alternate provisions to accommodate natural attenuation.
(2) Surface water discharge compliance consists of meeting the to-be-established discharge requirements for treated waters to the Roanoke River. Although the current surface water quality standard for mercury (0.012 μg/L) is not a set discharge criterion, the alternative contains a surface water discharge component for which the mercury concentration will likely exceed 0.012 μg/L.
(3) The estimated mass flux of mercury is from the FCP area to the Roanoke River. The percent reduction of the aqueous mercury mass flux is compared to the No Action Alternative (5.4 g/year).
(4) Costs presented in this table are in addition to the $1.3MM source removal costs spent to date.
** Consistently achieving the surface water discharge requirements for mercury may not be technically feasible.
N/A = not applicable.

K. Summary of Comparative Analysis of Alternatives

In this section, each alternative is assessed using nine evaluation criteria required under the NCP (NCP§300.430 (f)(5)(i)). The seven threshold and balancing criteria serve as the basis for conducting the detailed and comparative analysis of the Alternatives presented in the previous section. Comparison of the alternatives with respect to these evaluation criteria are presented in summary form This approach is designed to provide sufficient information to adequately compare the alternatives, aid in the selection of an appropriate remedy for the Site, and demonstrate satisfaction of the statutory requirements.

The evaluation criteria are briefly described below. **Table K-1** presents the comparison of the alternatives with respect to the evaluation criteria (without State and Community acceptance), and in relation to one another.

Threshold Criteria

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARS)

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs", unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental of State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

To-Be-Considered Requirements (TBCs) are Federal and State environmental and public health agency criteria, advisories, guidance, and proposed standards that are not legally enforceable but contain information that is useful in carrying out, or in determining the level of protectiveness of, selected remedies. TBCs are meant to compliment the use of ARARs, not to compete with or replace them. Because TBCs are not ARARS, their identification and use are not mandatory. Where no ARARs address a particular situation at a CERCLA site, or the existing ARARs do not ensure sufficient protectiveness, the TBC advisory, criteria or guidelines should be used to evaluate alternative remedial actions.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of Federal and State environmental statutes, or provides a basis for invoking a waiver.

Balancing Criteria

3. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy, and examines the extent to which the remedial alternative achieves the statutory preference for corrective action that permanently and significantly reduces the toxicity, mobility, and volume of contaminants.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until clean-up levels are achieved.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

7. Cost

The estimated present worth costs for the alternatives range from $ 215,785 for Five year reviews under Alternative 1 to $ 17,619,000 for Alternative 7.

Modifying Criteria

8. State Acceptance

The State of North Carolina supports Alternatives 4 through 7.

9. Community Acceptance

During the public comment period, the community supported the need for remedial action, and there was support for Alternative 4 and Alternative 7.

Table K-1 (Continued)
Comparative Analysis of Alternatives
Former Chlorine Plant

[illegible]	ALTERNATIVE 1 (No Action)	ALTERNATIVE 2 (Cooling Tower Repair and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 3 (Extended Flow Path and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 4 (Containment with Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 5 (Funnel and Gate System)	ALTERNATIVE 6 (Groundwater Extraction and Treatment)	ALTERNATIVE 7 (Mass Excavation)
Overall Protection of Human Health and the Environment (Continued)				"Target area" excavation and removal provides further protection of human health and the environment through the direct removal of mercury mass. This would reduce potential future direct contact hazards as well as decrease source area soil volume that could impact groundwater.	Same as Alternative 4.	Same as Alternative 4. Only one "target area" would be excavated under Alternative 6.	
Compliance with ARARS	Currently not in compliance with proposed North Carolina groundwater standards for total mercury.	Would not be expected to achieve the chemical-specific groundwater ARAR (NCMAC of 1.1 mg/L for total mercury). However, the administrative provisions of the 15A NCAC provide alternative means of achieving compliance.	Would not be expected to achieve the chemical-specific groundwater ARAR (NCMAC of 1.1 mg/L for total mercury). However, the administrative provisions of the 15A NCAC provide alternative means of achieving compliance.	Would not be expected to immediately achieve the chemical-specific ARAR outside of the contained area. Although the chemical-specific ARAR would not be immediately met, concentrations in groundwater would likely reduce through time as a result of natural processes. The administrative provisions of the 15A NCAC provide alternative means of achieving compliance.	Same as Alternative 4. Chemical-specific ARAR for groundwater would be met in the groundwater discharging through the reactive gate.	Flocculation, carbon adsorption, and ion exchange would remove mercury from the collected source area groundwater, followed by the surface water discharge of remediation effluent. It is not anticipated that the treated effluent could consistently meet the 0.012 µg/L surface water criteria.	Would not be expected to immediately achieve the chemical-specific ARAR outside of the excavation area; however, through the removal of the source area soil and groundwater, concentrations in groundwater would likely rapidly reduce through time as a result of natural processes. The administrative provisions of the 15A NCAC provide alternative means of achieving compliance.
		The mass flux in groundwater discharged to the river would be further reduced as water infiltration through the source area is reduced.	The concentrations and mass flux in groundwater discharged to the river would temporarily be further reduced as the extended flow path retards the arrival of the mercury.	Physical containment and "target area" excavation and removal would decrease future concentrations of mercury in groundwater discharging to the river.	Same as Alternative 4.	Although the action-specific surface water ARAR would likely not be met in treatment system effluent, concentrations in groundwater that flows from the source area to the Roanoke River would be reduced as a result of treatment. "Target area" excavation and removal would aid in decreasing future concentrations of mercury in groundwater.	
		Can achieve all applicable location- and action-specific ARARs.	Can achieve all applicable location- and action-specific ARARs. Additional permitting may be required for the bulkhead construction in the Roanoke River.	Can achieve all applicable location- and action-specific ARARs.	Can achieve all applicable location- and action-specific ARARs.	Can achieve all applicable location-specific ARARs.	Can achieve all applicable location- and action-specific ARARs.

Table K-1
Comparative Analysis of Alternatives
Former Chlorine Plant

	ALTERNATIVE 1 (No Action)	ALTERNATIVE 2 (Cooling Tower Repair and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 3 (Extended Flow Path and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 4 (Containment with Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 5 (Funnel and Gate System)	ALTERNATIVE 6 (Groundwater Extraction and Treatment)	ALTERNATIVE 7 (Mass Excavation)
Description	No Further Action.	Repair of the existing leaking cooling tower thus decreasing the amount of infiltration through the source area and mercury flux to the river, Inspection of river bulkhead to assess physical integrity.	Extension of the groundwater flow path through improvements to the existing bulkhead wall adjacent to the river. Increase the volume of aquifer solids over which natural process or dispersion and adsorption can occur.	Installation of barrier wall system around the source area to reduce the mass flux of mercury in groundwater from the target area.	Installation of a funnel wall system bracketing a targeted source area to effectively capture and channel the impacted groundwater within the target area through a treatment gate that will remove aqueous mercury.	Installation of a multiple well extraction system, conveyance system, *ex situ* groundwater treatment via flocculation, carbon adsorption, ion exchange, and surface water discharge.	Mass excavation and removal of source area soil.
		Institutional controls and monitoring of groundwater.	Institutional controls and monitoring of groundwater.	Institutional controls and monitoring of groundwater.	Institutional controls and monitoring of groundwater.	Institutional controls and monitoring of groundwater.	Institutional controls and monitoring of groundwater.
		Modeling and assessment of effectiveness at 5-year intervals.		Excavation of two "target area" source area locations outside of containment area.	Excavation of two "target area" source area locations outside of containment area.	Excavation of one "target area" source area location outside of containment area.	
Overall Protection of Human Health and the Environment	No action alternative does not modify current exposure pathways	Protective of human health and the environment by eliminating the exposure pathway to site soil and groundwater. Soil pathway would be eliminated by the installation of the concrete cover over currently unpaved "source area" soil. Groundwater pathway would be eliminated by preventing installation of potable water wells in the vicinity of the FCP. The repair of the cooling tower leak(s) is expected to significantly decrease the discharge of mercury into the river by reducing the amount of infiltration through the source area.	Same as Alternative 2. In addition, the installation of the sealed bulkhead along the river would lengthen the flow path of impacted groundwater, which is expected to retard the discharge of mercury into the river.	Same as Alternative 2. With respect to groundwater outside of the containment footprint, this alternative would not provide immediate overall protection of the environment, but exposure of potential ecological receptors to mercury in discharging groundwater would decrease over time through natural processes and the fact that source area groundwater is contained within the barrier wall. The barrier wall would inhibit source area groundwater from hydraulically communicating and migrating to the Roanoke River.	Same as Alternative 4. In addition, source area groundwater within the containment area would be directed through a reactive treatment gate that would remove mercury from the groundwater as it passes through the gate.	Protective of human health and the environment by eliminating the exposure pathway to site soil and groundwater. Soil pathway would be eliminated by the installation of the concrete over over currently unpaved "source area" soil. Groundwater pathway would be eliminated by preventing the installation of potable water well in the vicinity of the FCP. For groundwater outside of the hydraulic containment area that is discharging into the Roanoke River, this alternative would not provide immediate overall protection of the environment, but exposure of potential ecological receptors to mercury in discharging groundwater would decrease over time through natural processes The hydraulic containment provided by the extraction network would inhibit source area groundwater from migrating to the Roanoke River.	Protective of human health and the environment by eliminating the exposure pathway to site soil and groundwater. Soil pathway would be eliminated by the direct removal of mercury mass via soil excavation; however, it would be simply transferred to another location (landfill) to be permanently managed/monitored. Groundwater pathway would be eliminated by preventing the installation of potable water wells in the vicinity of the FCP. For groundwater outside of the excavation footprint that is discharging into the Roanoke River, this alternative would not provide immediate overall protection of the environment, but exposure of potential ecological receptors to mercury in discharging groundwater would decrease over time through natural processes and the fact that source area soil and groundwater are removed from the site via excavation.

Table K-1 (Continued)
Comparative Analysis of Alternatives
Former Chlorine Plant

[illegible]	ALTERNATIVE 1 (No Action)	ALTERNATIVE 2 (Cooling Tower Repair and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 3 (Extended Flow Path and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 4 (Containment with Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 5 (Funnel and Gate System)	ALTERNATIVE 6 (Groundwater Extraction and Treatment)	ALTERNATIVE 7 (Mass Excavation)
Long-Term Effectiveness and Permanence	Would not provide a long-term permanent solution for human and ecological exposure to mercury in soil or groundwater. The alluvial aquifer in the area of the FCP is not currently used.	Could be both effective and reliable over the long term as a means of assisting in reducing potential human health and ecological risks at the site. Reductions in exposure would be attributable to paving and land use restrictions. The cooling tower repairs would decrease the infiltration volume passing through the source area and, in turn, reduce the mass flux of mercury discharging into the Roanoke River.	Could be both effective and reliable over the long term as a means of assisting in reducing potential human health and ecological risks at the site. Reductions in exposure would be attributable to paving and land use restrictions. The sealed bulkhead would lengthen the groundwater flow path and retard the arrival of mercury discharging into the Roanoke River.	Could be both effective and reliable over the long term as a means of assisting in reducing potential human health and ecological risks at the site. These reductions in exposure would be attributable to paving, land use restrictions, soil removal, groundwater containment, and natural processes. The vertical barrier wall would contain impacted groundwater and soil exceeding cleanup criteria. "Target area" removal of area soil would effectively permanently reduce the long-term on-site risks associated with targeted source soil. Natural processes can be effective in reducing mercury concentrations in groundwater.	Same as Alternative 4. A treatment gate would increase effectiveness in reducing mercury concentrations in groundwater departing from the source area. Gate material may require replacement in time. Would likely significantly reduce the long-term mass flux of dissolved mercury to the Roanoke River.	Could be both effective and reliable over the long term as a means of assisting in reducing potential human health and ecological risks at the site. These reductions in exposure would be attributable to paving, land use restrictions, groundwater removal, and natural processes. The extraction system would contain source area groundwater. Flocculation, carbon adsorption, and ion exchange would permanently remove mercury from the extracted groundwater. "Target area" removal of area soil would effectively permanently reduce the long-term on-site risks associated with targeted source soil. Outside of the capture zone, natural processes can be effective in reducing mercury concentrations in groundwater.	Could be both effective and reliable over the long term as a means of assisting in reducing potential human health and ecological risks at the site. These reductions in exposure would be attributable to land use restrictions, soil and associated groundwater removal, and natural processes. Excavation and disposal of source area soil would significantly reduce the long-term on-site risks associated with source area soil and the mass flux of mercury to the river; however, the mercury mass would be transferred to another location (landfill) where it would have to be permanently monitored and managed for the duration specified in the landfill permit (minimum of 30 years following closure). Natural processes can be effective in reducing mercury concentrations in groundwater.
Reduction of Toxicity, Mobility, and Volume	May reduce the concentration of COC in groundwater through natural processes.	Surface pavement will decrease the infiltration of precipitation through impacted soil and thereby reduce the movement of mercury. No decrease in constituent toxicity or volume is anticipated from the implementation of the surface cover. The repair of the cooling tower would reduce the volume of water infiltrating through the source area and, in turn, reduce the mobility and flux rate of mercury to the river.	Surface pavement will decrease the infiltration of precipitation through impacted soil and thereby reduce the movement of mercury. No decrease in constituent toxicity or volume is anticipated from the implementation of the surface cover. The installation of the sealed bulkhead would increase the groundwater flow path distance between the source area and the river discharge point. Although there is no decrease in overall volume or toxicity owing to this elongated flow path, the mobility is affected, retarding the arrival of mercury at the river.	Surface pavement will decrease the infiltration of precipitation through impacted soil and thereby reduce the movement of mercury. No decrease in constituent toxicity or volume is anticipated from the implementation of the surface cover. The installation of the sealed containment area would significantly reduce the mobility of source area mercury. Although the overall volume would remain the same, the *on-site* mass of mercury within source area soil would be reduced through excavation and off-site disposal of "target areas." By removing this soil, continued groundwater impacts are reduced. A portion of the excavated soil may require pretreatment prior to disposal, whereby mercury could be recovered and recycled from the source soil.	Same as Alternative 4. In addition, although the total overall mass remains the same, the mercury mass would be removed from groundwater that passes through the treatment gate. Upon removal of the spent treatment media, the mercury mass would be permanently removed from the site.	Surface pavement will decrease the infiltration of precipitation through impacted soil and thereby reduce the movement of mercury. No decrease in constituent toxicity or volume is anticipated from the implementation of the surface cover. Although the total overall mass remains the same, the mercury mass would be removed from groundwater that passes through the treatment system. Upon the removal of the spent treatment media and the precipitated and dewatered sludge, the mercury mass would be permanently removed from the site. On-site mass of mercury within "target area" source area soil would be further reduced through excavation and landfill disposal.	Although the overall mass of mercury would remain the same, the *on-site* mass and volume of mercury would be reduced through excavation and off-site disposal. By removing this soil, continued on-site groundwater impacts are also reduced. A portion of the excavated soil may require pretreatment prior to disposal, whereby mercury could be recovered and recycled from the source soil, although a portion would also be released into the atmosphere during this pretreatment process.
	Current mercury mass flux from the "source area" to the river is estimated to be 5.4 grams per year.	Mercury mass flux from the "source area" to the river is expected to be 3.2 grams per year, a 41 percent reduction.	The mercury mass flux from the "source area" to the river is expected to be 0.91 gram per year, a 83 percent reduction.	Mercury mass flux from the "source area" to the river is expected to be 0.14 gram per year, a 97 percent reduction.	Mercury mass flux from the "source area" to the river is expected to be 0.32 gram per year, a 94 percent reduction.	The mercury mass flux from the "source area" to the river is expected to be 4.6 to 4.8 gram per year, a 11-15 percent reduction.	The mercury mass flux from the "source area" to the river is expected to be 0.

Table K-1 (Continued)
Comparative Analysis of Alternatives
Former Chlorine Plant

[illegible]	ALTERNATIVE 1 (No Action)	ALTERNATIVE 2 (Cooling Tower Repair and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 3 (Extended Flow Path and Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 4 (Containment with Groundwater Compliance and Trend Monitoring)	ALTERNATIVE 5 (Funnel and Gate System)	ALTERNATIVE 6 (Groundwater Extraction and Treatment)	ALTERNATIVE 7 (Mass Excavation)
Short-Term Effectiveness	Not applicable.	Would have very limited adverse effects on the community, employee health, and the environment during implementation. Direct contact risks associated with groundwater monitoring are limited.	Would have some adverse effects on the community, employee health, and the environment during implementation. The presence of equipment barges and ancillary equipment required to complete construction would interrupt river boat traffic. Sediment would also be disturbed as a result of sheet piling installation activities. Direct contact risks associated with groundwater monitoring are limited.	Would have few adverse effects on the community, employee health, or the environment during implementation. One of the effects would be soil disturbance during source area soil excavation and removal. Short-term direct contact, and spill risks are associated with soil excavation and transportation. Direct contact risks associated with groundwater monitoring are limited.	Same as Alternative 4. Handling of spent treatment media would be an additional short-term risk associated with media removal and replacement.	Would have few adverse effects on the community, employee health, or the environment during implementation. Identified effects would be soil disturbance during "target area" excavation and extraction and conveyance system installation and contact risks during system sampling and monitoring. Short-term direct contact, and spill risks are associated with spent carbon removal and transportation.	Would have significant effects on the community, employee health, or the environment during implementation. Risks include exposure to source area soil and groundwater during extensive excavation, heavy traffic in the area of excavation both by removal contractors as well as current plant activities, potential spills during transportation and disposal. Direct worker exposure to concentrated mercury in the subsurface soil would occur during excavation activities.
Implementability	Not applicable.	All components are implementable on both a technical and an administrative level. Cooling tower repairs would have to be scheduled and coincide with a planned facility down time as repair of the cooling tower would shut-down mill operations.	All components are implementable on both a technical and an administrative level. The equipment, materials, and personnel required to implement this remedial alternative are readily available. The bulkhead replacement would require a planning and scheduling effort, as it would require specialized equipment and river traffic considerations; but this technology is well established and could be initiated at any time.	All components are implementable on both a technical and an administrative level. The implementation of this alternative would disturb *in situ* soil and groundwater. Workers would be exposed to constituents in groundwater under this alternative during soil excavation, drilling, and/or sampling of monitoring wells. Workers involved with soil excavation, barrier wall construction, well installation, and groundwater sampling would have safety training and would wear appropriate personal protective equipment. The equipment, materials, and personnel required to implement this remedial alternative are available. Implementation would require a significant planning and scheduling effort, as it requires significant work and excavation in a very active portion of the site. This technology is well established.	Same as Alternative 4. Additional materials and effort would be required for construction of the treatment gate. Although promising, treatment gates for mercury removal are a less established technology. Would require media replacement at infrequent intervals. Such replacement would be a significant effort.	All components are implementable on both a technical and an administrative level. The implementation of this alternative would have minimal disturbance of *in situ* soil and groundwater. The equipment, materials, and personnel required to implement this remedial alternative are readily available. The target area excavation and extraction and conveyance system construction would require a planning and scheduling effort to coincide with plant traffic and activities, but this technology is well established and could be initiated at any time.	Although significantly complex, the components of this alternative can be implemented on both a technical and an administrative level. The implementation of this alternative would include significant disturbance of *in situ* source area soil and groundwater. The extensive excavation would require considerable planning and scheduling efforts owing to on-site traffic considerations and plant operations, but excavation and removal technologies are well established. Plant traffic and site operations would be significantly affected for a considerable amount of time, as the excavation would have to be performed in stages to allow some plant operations in the area. Deep excavations would require significant engineering controls.
Relative Cost	No costs associated with the No Action alternative.	Low relative capital cost.	Medium relative capital cost.	Medium to high relative capital cost.	Medium to high relative capital cost.	Low to medium relative capital cost.	High relative capital cost.
		Low to medium relative O&M Present Worth.	Medium relative O&M Present Worth.	Medium relative O&M Present Worth.	Medium relative O&M Present Worth.	High relative O&M Present Worth.	Low relative O&M Present Worth.
		Low relative NPW cost.	Medium relative NPW cost.	Medium to high relative NPW cost.	Medium to high relative NPW cost.	High relative NPW cost.	High relative NPW cost.

L. Principal Threat Wastes

The NCP establishes an expectation that EPA use treatment to address the principal threats posed by a site wherever practical (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat waste combines concepts of both hazard and risk. In general, principal threat waste are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. The mercury contaminated soils are considered to be "principal threat wastes".

Mercury is a highly toxic substance, and is present in high quantities at the site. There is a significant possibility that, absent remedial action, a release of the large quantities of mercury present in on-site subsurface soils may occur, resulting in an unacceptable risk. The alternatives which address the containment or excavation of the mercury contaminated soils address this risk. Alternatives 1, No-action, would not address the principal threats at the site. Alternatives 2, 3, and 6 are groundwater alternatives and do not address the contaminated soil. Alternative 5 provides for partial containment of contaminated soils, and some excavation, but is still primarily a groundwater alternative. Alternative 4 provides for effective containment of the majority of the soil contaminated with mercury, and some limited excavation, treatment and disposal. Alternative 7 would significantly reduce the risk by excavation, treatment and off-site disposal.

M. The Selected Remedy

The Selected Remedy for the Former Chlorine Plant Area is Alternative 4-Containment with Groundwater Compliance Monitoring and Trend Monitoring.

1. Summary of the Rationale for the Selected Remedy

Alternative 4 provides the best balance of the nine evaluation criteria of all of the Alternative remedies reviewed for the site. In terms of the balancing criteria, Alternative 4 provides for protection of human health and the environment through the installation of a barrier system around the mercury contaminated soils, excavation of soils adjacent to the river, groundwater compliance monitoring, and land and groundwater use restrictions. The barrier system will prevent a catastrophic release of the nearly 7,500 pounds of mercury present in on-site soils to the adjacent Roanoke River. Alternative 4 would allow the groundwater outside of the barrier wall to remain above the chemical-specific ARAR for total mercury of 1.1 μg/L, however the groundwater is expected to naturally recover with time and will be monitored for compliance. In the interim, groundwater potable use restriction will prevent exposure to mercury in the shallow aquifer.

Alternative 4 will be effective and reliable over the long term by containing impacted soil and residual groundwater within the containment barrier system. Alternatives 1, 2, 3, 5 and 6 are primarily groundwater alternatives which do not address the principal threat of the mercury contaminated soil. Alternative 4 would effectively and permanently remove the source materials in Areas 1 and 2. Only Alternative 7 provided for a permanent removal of all of the principal threat waste.

Natural processes should be effective with time in reducing residual groundwater contamination outside of the barrier system. Alternative 5 and 6 are more active groundwater treatment remedies, but the groundwater restoration time frames are still in the hundreds of thousands of years. Surface pavement and the barrier system will reduce the mobility of the largest source of mercury in soils. Excavation in limited source Areas 1 and 2 will remove these source areas and reduce their impacts to groundwater. Mercury flux from the source area to the river is expected to be reduced by 97 percent.

All components of Alternative 4 are implementable in the short term, and should have minimal adverse effects on the community, employee health or the environment during implementation, although the work will be performed in a very active portion of the facility and will require extensive planning. Only Alternatives 1 and 2 are more easily implemented than Alternative 4. The remainder of the alternatives will be disruptive in the short term. Alternative 7 would present the highest degree of difficulty for implementation of 10 phased excavations, and would also present significant worker health and safety concerns. The equipment and personnel required to implement Alternative 4 are available, and workers would have safety training and wear appropriate personal protective equipment.

2. Description of the Selected Remedy

This alternative consists of the installation of a vertical barrier wall system around the source area, and "targeted" excavation of soil from the Central U-drain area and the Eastern U-drain area. Various types of barrier walls can be utilized for the containment of mercury contaminated soils in the Former Chlorine Plant building footprint. For purposes of cost estimating in the FS, a sealed sheet pile barrier wall was evaluated. The final material will be determined during remedial design but shall meet the specifications that follow.

The wall enclosing the source area will consist of a sealed/low permeability barrier, with an estimated permeability of 5.0×10^{-8} cm/s. The wall will be installed to approximately 45 feet below ground surface, tying into the low-permeability clay aquitard beneath the site. The conceptual wall has a total length of 610 feet, and would enclose an area of approximately 23,000 square feet and a volume of approximately 38,000 cubic yards of soil. Approximately 7,200 pounds of mercury (or 96 percent of the estimated total mass of mercury) will be enclosed by the barrier.

Also included in this alternative are two "target area" excavations. These target areas include excavation of both saturated and unsaturated soil. The excavations will extend to the practicable horizon and vertical limits near the former hypochlorite tank/central U-drain (Area 1) and along the Eastern U-drain (Area 2). The excavations will removed surface soil and subsurface soil to a mercury level of 20 mg/kg. Structural sheet piling will be utilized for excavation stabilization and shoring. It is assumed that interlocking sheet piling will be driven to 25 feet around Area 1 and 20 feet around Area 2. No de-watering of soil is anticipated. Solidification of excavated, saturated soil will be performed in constructed bunkers with the addition of a solidification agent such as fly ash. Area 1 has a surface area of approximately 2,000 square feet. At an average depth of 10 feet, excavation would remove approximately 750 cubic yards of soil. About 80 pounds of mercury would be removed from Area 1 (approximately 1 percent of the estimated total mass of mercury). Area 2 measures approximately 10 feet by 55 feet, and at an average depth of 8 feet, a total of 150 cubic yards of soil would be excavated, containing approximately 230 pounds of mercury (about 3 percent of the total mass of mercury).

The Toxicity Characteristic Leaching Procedure (TCLP) limit for mercury (40 CFR 261.24) is 0.2 mg/L. The TCLP values for the shallow soil samples from the Former Chlorine Plant have historically not exceeded 0.09 mg/L, even in soil with total mercury concentrations as high as 2,900 mg/kg. If TCLP results are above 0.2 mg/L and total mercury concentrations are greater than or equal to 260 mg/kg (40 CFR 268.40), then the material must be retorted (or equivalent process) to recover and recycle the mercury as per the Universal Treatment Standard (UTS). For purposes of cost estimating it was assumed that materials from Area 1 would be nonhazardous as defined by the TCLP. In Area 2, it was assumed that 50 percent of the excavated material would be nonhazardous and 50 percent would be hazardous. The nonhazardous materials would be disposed of at the facilities nonhazardous landfill, or off-site at a nonhazardous landfill, and the hazardous material will be sent to an off-site retort facility for treatment prior to disposal. The excavations will be backfilled with clean fill material and covered.

The surface cap containment system will require the replacement of pavement over areas disturbed by the barrier wall installation, the excavations, and the currently un-covered surface soil adjacent to the river.

To assess the mercury concentration trends in groundwater, this alternative includes the implementation of a groundwater compliance and trend monitoring program consisting of 12 monitoring wells sampled over 30 years.

The land use restrictions would preclude the potable use of groundwater from the shallow aquifer beneath the Former Chlorine Plant and mercury plume areas. Currently, a map is on file with the Martin County Register of Deeds that identifies the Former Chlorine Plant Area as an Inactive Hazardous Substance or Waste Disposal Site (NCD 991-278-540). To the extent necessary, this deed notice will be revised as a part of the remedial design to reflect the selected remedy, to meet the current North Carolina administrative process, and any additional requirements to maintain the integrity of the remedy and to limit exposure to soil and groundwater.

The remedy described in this section may change somewhat as a result of the remedial design and construction processes. Changes to the remedy described in this ROD will be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences (ESD) or by a ROD Amendment, depending on the magnitude of the proposed change.

3. Summary of the Estimated Remedy Cost

The detailed cost estimate for Alternative 4 is shown on **Table M-1**. The cost estimate presents the capital, annual O&M, and total present worth costs projected over 30 years. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD or a ROD amendment. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the actual projected cost.

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Alt[illegible]e 4
Conceptual Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Costs	Comments
1. Mobilization/Demobilization/Site Preparation	LS	1	$240,000	$240,000	Includes equipment mob/demob &
Subtotal				$240,000	transportation of sheetpile/materials
2. Sheeting Installation in FCP Area					610 LF x 45 ft deep
a. WEZ95 Sheeting	SF	27,450	$18	$494,100	
b. Corners	VF	180	$90	$16,200	4 corners, 45 ft deep
c. Waterloo Barrier Seal	SF	27,450	$10	$274,500	Includes material, installation, and QA/QC
d. Equipment & Labor	WK	6	$90,000	$540,000	
Subtotal				$1,324,800	
3. Target Area Excavation					
a. Area 1 Shoring	SF	5,000	$15	$75,000	200 ft perimeter x 25 ft deep
b. Area 2 Shoring	SF	2,600	$15	$39,000	130 ft perimeter x 20 ft deep
c. Excavation	CY	900	$8	$7,200	area 1 = 750 cy, area 2 = 150 cy
d. Solidification Treatment Bunker	LS	1	$50,000	$50,000	
e. Handling / Disposal					Total excavation material, assumes 1.4 tons/cy unit weight
i) Solidification Agent	TN	126	$15	$1,890	Assumes 10% by weight addition of solidification agent
ii) Solidification Mixing	TN	1,386	$5	$6,930	
iii) Non-hazardous Disposal	TN	1,271	$25	$31,763	Assumes 100% of area 1 and 50% of area 2 is non-haz to onsite LF
iv) Hazardous Disposal	TN	116	$2,000	$231,000	Assumes 50% of area 2 requires haz disposal at retort facility
f. Confirmation Soil Sampling	CY	900	$10	$9,000	USEPA Guidance, July 2000
g. Backfill/Compact with Clean Soil	CY	900	$22	$19,800	Sand fill placement and compaction
h. Health and Safety Monitoring	Day	5	$1,000	$5,000	
Subtotal				$476,583	
4. Miscellaneous Costs					
a. Relocate Oil Storage Area	LS	1	$100,000	$100,000	
b. Concrete Surface Demo & Repair	SF	3,770	$25	$94,250	Surface concrete in areas of sheetpiling and areas to be excavated
c. Utility Penetrations/Relocations	EA	10	$10,000	$100,000	(610 ft x 2 ft + 50 ft x 30 ft + 25 ft x 20 ft + 10 ft x 55 ft)
d. Surface Capping	SF	1,600	$20	$32,000	10 ft by 160 ft area of concrete pavement
e. Deed Restrictions	LS	1	$20,000	$20,000	
f. Staging Area Development	LS	1	$100,000	$100,000	
g. Site Restoration	LS	1	$100,000	$100,000	
h. Cooling Tower Evaluation and Repairs	LS	1	$165,000	$165,000	
Subtotal				$711,250	
5. Subtotal Direct Capital Costs				$2,752,633	
6. Facility Support and Corporate Costs	10%			$275,263	Weyerhaeuser
7. Professional/Technical Services					
a. Project Management	10%			$275,263	10% of direct capital
b. Remedial Design	12%			$330,316	12% of direct capital
c. Construction Management	12%			$330,316	12% of direct capital
d. Regulatory Interaction	8%			$220,211	8% of direct capital
8. Contingency	30%			$825,790	15% scope and 15% bid contingency of direct capital
TOTAL CAPITAL COSTS				**$5,010,000**	
ANNUAL OPERATION, MAINTENANCE, AND MONITORING (O&M) COSTS					
1. Groundwater Performance Monitoring (Annual)					
a. Field Effort (labor)	HR	60	$75	$4,500	Assumes 2 people for 3 days
b. Expenses (vehicle, equipment, lodging)	DY	3	$250	$750	
c. Sample Analyses	TEST	14	$200	$2,800	Assumes 12 wells and 2 QA/QC duplicates
d. Data Analysis/Reporting	LS	1	$20,000	$20,000	
e. Cooling Tower Assessment	LS	1	$10,000	$10,000	
2. Subtotal O&M Costs				$38,050	
3. Contingency	30%			$11,415	10% scope + 20% bid
Total Annual O&M Costs				$49,465	
TOTAL O&M PRESENT WORTH				**$614,000**	30 years at 7%
PRESENT WORTH OF ALTERNATIVE				**$5,624,000**	

Notes:

1. Costs assume that the mill loading docks will not be relocated.

4. Expected Outcomes of the Selected Remedy

Former Chlorine Plant Area Clean-up Levels

The cleanup levels selected for the contaminated media at the Former Chlorine Plant Area were developed using the results of the risk assessment and by comparison to ARARs. A risk-based cleanup level was derived for soil as well as a level that was protective of groundwater. The soil cleanup level was derived using partitioning coefficient calculations, which result in no exceedence of groundwater standards. This level was lower than the risk-based soil exposure level, and is therefore selected as the soil cleanup level. **Table M-2** provides the cleanup levels for the Former Chlorine Plant Area.

Table M-2
Cleanup Levels for the Former Chlorine Plant Area

Media	Total Mercury Cleanup Level	Derived From
Soil	20 mg/kg	Protection of groundwater
Groundwater	1.1 μg/L	ARAR[1]
Surface water	0.012 μg/L	ARAR[2]

[1] North Carolina Maximum Allowable Concentrations (North Carolina 2L standards) Title 15A NCAC Subchapter 2L.0101, .0102, .0103, .0105, .0106, .0109, .0110, .0111, .0112, .0113, .0114, .0201, .0202, and .0315-**Applicable**
[2] North Carolina Fresh Surface Water Quality Standards for Class C Waters, Title 15A, NCAC Subchapter 2B .0110, .0200-**Applicable**

Available uses of Land

The Former Chlorine Plant Area will be returned to it's current use at the Weyerhaeuser facility. The institutional controls will prevent future residential land and groundwater use. The area is expected to remain an active industrial facility in the future.

N. Statutory Determination

The purpose of this section is to provide a description of how Alternative 4 satisfies the statutory requirements of CERCLA §121 (as required by NCP §300.430 (f)(5)(ii)) and explain the Five-Year Review requirements for the Former Chlorine Plant Area.

1. Protection of Human Health and the Environment

Alternative 4 is protective of human health and the environment by eliminating, reducing, or controlling risk posed by the Former Chlorine Plant Area through containment of contaminated soils, "targeted" excavation in the U-drains, groundwater monitoring and institutional controls.

The containment of the contaminated soils is justified even though current conditions have not resulted in a release posing risk. There is a significant possibility that, absent remedial action, a release of the large quantities of mercury present in on-site subsurface soils may occur, resulting in an unacceptable risk. The significance of this potential risk was evaluated based on the quantities of mercury (approximately 7,500 lbs) in soil as well as the environmental setting of the Former Chlorine Plant Area adjacent to the Roanoke River (EPA, 1991). In addition, where factors such as complex hydrogeology or contaminant characteristics constrain groundwater restoration, EPA's approach is to emphasize removal or treatment of source materials, containment of non-restorable source areas, and restoration of aqueous contaminant plumes (EPA, 1995).

The barrier wall containment system would effectively control the migration of mercury from the source area into groundwater and from migrating to the Roanoke River. Under this Alternative, the mass flux of mercury from the Former Chlorine Plant Area to the Roanoke River would be decreased by 94 percent, compared to the no further action Alternative. The potential exposure pathway for groundwater would be eliminated by preventing installation of potable water wells in the vicinity of the Former Chlorine Plant Area.

By performing the "target" area excavations, treatment and disposal, Alternative 4 incorporates a treatment component as well a provides further protection of human health and the environment. The mass removal would reduce potential future direct contact hazards as well as decrease source area mercury mass that could impact groundwater and the Roanoke River.

2. Compliance with Applicable or Relevant and Appropriate Requirements

Chemical Specific ARARS

Chemical-specific ARARs are federal and state requirements that define acceptable exposure levels and might, therefore, be used in establishing remediation goals. No chemical-specific ARARs are available for mercury in soil.

The following **Table N-1** lists the state and federal chemical-specific mercury ARAR for groundwater, and for groundwater discharge to the Roanoke River. The North Carolina Maximum Allowable Concentration is Applicable, because the State of North Carolina considers all waters not otherwise restricted to be potentially potable. The federal drinking water standard, MCLs, is relevant and appropriate rather than applicable since there is no currently completed pathway for groundwater to be used as potable water (i.e., groundwater is not used for drinking water purposes). The North Carolina Fresh Surface Water Quality Standards area Applicable.

Table N-1
Chemical-Specific ARARS

Constituent of Concern	North Carolina Groundwater Quality Standard[1] (µg/L)	Federal Primary Drinking Water Standard[2] (µg/L)	North Carolina Surface Water Quality Standard[3] (µg/L)
Mercury	1.1	2.0	0.012

[1] North Carolina Maximum Allowable Concentrations (North Carolina 2L standards) Title 15A NCAC Subchapter 2L.0101, .0102, .0103, .0105, .0106, .0109, .0110, .0111, .0112, .0113, .0114, .0201, .0202, and .0315-**Applicable**
[2] Primary Drinking Water Standards or MCLs as promulgated under the Safe Drinking Water Act (SDWA)-**Relevant and Appropriate**
[3] North Carolina Fresh Surface Water Quality Standards for Class C Waters, Title 15A, NCAC Subchapter 2B .0110, .0200-**Applicable**

Location Specific ARARS

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely on the basis of location. Examples of location-specific ARARs include solid and hazardous waste facility siting criteria and state and federal requirements to protect flood plains, critical habitats, and wetlands. A summary of location-specific ARARs for Alternative 4 is presented in **Table N-2**.

Table N-2
Location-Specific ARARs
Former Chlorine Plant

LOCATION	CITATION	DESCRIPTION
State Location-Specific ARARs		
Within 100-year flood plain	General Solid Waste Location Standard (15A NCAC Chapter 13B)	General location requirements for disposal facilities.
Area affecting coastal area waters	North Carolina Coastal Area Management Act (NCGS Chapter 113 A, Article 7)	Establishes criteria for protection, preservation, and conservation of coastal areas.
Federal Location-Specific ARARs		
Flood Plain Management	40 CFR 6, Appendix A 10 CFR 1022	In 100-year flood plains, actions must be taken to reduce the risk of flood loss, minimize the impact of floods on human safety, and restore and preserve the natural and beneficial values of flood plains.
	40 CFR 122	In areas that potentially erode or release sediment, controls and best management practices are to be used to control runoff from construction activities.
National Historic Preservation Act	16 USC 470 40 FR 6.301(b) 36 CFR Part 800	Requires federal agencies to take into account the effect of any federally assisted undertaking of licensing in any district site building, structure, or object that is included in, or eligible for inclusion in, the National Register of Historic Places.

Table N-2 (Continued)
Location-Specific ARARs
Former Chlorine Plant

LOCATION	CITATION	DESCRIPTION
Federal Location-Specific ARARs (Continued)		
Archaeological and Historic Preservation Act	16 USC 469	Establishes procedures to provide for preservation of historical and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project of a federally licensed activity or program.
Historic Sites, Buildings, and Antiquities Act	16 USC 461-467	Requires federal agencies to consider the existence and location of landmarks on the National Registry of Landmarks to avoid undesirable impacts on such landmarks.
Fish and Wildlife Coordination Act	16 USC 661-666	Requires consultation when activities modify any stream or other water body adequate for protection of fish and wildlife resources.
Endangered Species Act	16 USC 1531	Requires action to conserve endangered species within critical habitats on which endangered species depend and includes consultation with Department of Interior.
	50 CFR Part 200	
	50 CFR Part 402	
Coastal Zone Management Act	16 USC 1451	In coast zone areas, requires conducting activities in accordance with site-approved management program.

Action Specific ARARS

Action-specific ARARs are technology- or activity-based requirements or limitations on remedial actions that are implemented at the site. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. **Table N-3** presents the Action Specific ARARS for Alternative 4.

3. Cost-Effectiveness

This section describes how Alternative 4 meets the statutory requirement that all Superfund remedies be cost-effective. A cost-effective remedy is one whose "*costs are proportional to its overall effectiveness*" (NCP §400.430(f)(1)(ii)(D)). The overall effectiveness of a remedial alternative is determined by evaluating three of the five balancing criteria used in the detailed analysis of alternatives: (1) Long-term effectiveness; (2) Reduction of toxicity, mobility and volume; and (3) Short-term effectiveness. The overall effectiveness is then compared to the cost. In addition, the cost effectiveness of each alternative in relation to one another is also compared. **Table K-1** summarized the cost-effectiveness comparison of the remedial alternatives for the Former Chlorine Plant Area. Through this comparison, EPA has determined that Alternative 4 is a cost-effective remedy for the Former Chlorine Plant Area.

4. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

Alternative 4 is primarily a containment remedy. The excavation and off-site treatment of a limited quantity of the mercury contaminated soils in Areas 1 and 2 will provide permanent removal of only about 3% of the total mass of mercury in on-site soils. However, the containment barrier system will effectively contain the majority of the mass of mercury in place at the site, and will permanently reduce the mass flux of mercury to the groundwater and ultimately the Roanoke River by an estimated 97%.

As demonstrated during the treatability study work conducted for the site, treatment of mercury in groundwater is difficult and even when the use of sequential systems the effluent can not be reliably reduced to below surface water discharge standards. The residual groundwater contamination outside of the containment system will be reduced by natural processes within a reasonable period of time, but will not be effective in limiting future exposure to human receptors without the use of institutional controls. The same would hold true for all of the alternatives evaluated because each had some residual groundwater contamination which requires long-term monitoring.

5. Preference for Treatment as a Principal Element

Alternative 4 is primarily a containment alternative, but does include some limited excavation and treatment within the source Areas 1 and 2. Contaminants in soils and

Table N-3
Action-Specific ARARs
Former Chlorine Plant

STANDARD, REQUIREMENT, OR LIMITATION	CITATION	DESCRIPTION
State Action-Specific ARARs		
Identification and listing of hazardous waste	Title 15A NCAC Subchapter 13A.0006	Provides numerical criteria to determine those solid wastes that are subject to regulations as hazardous wastes.
Requirements for hazardous waste generators	Title 15A NCAC Subchapter 13A.0107	Establishes standards for generators of hazardous wastes.
Requirements for a hazardous waste transporter	Title 15A NCAC Subchapter 13A.0108	Establishes standards for transporters of hazardous wastes.
Requirements for a hazardous waste treatment, storage, or disposal facility	Title 15A NCAC Subchapter 13A.0109	Establishes standards for treaters, storers, or disposers of hazardous wastes.
Requirements for an interim status hazardous waste treatment, storage, or disposal facility	Title 15A NCAC Subchapter 13A.0110	Establishes standards for interim status treaters, storers, or disposers of hazardous wastes.
Treatment standards	Title 15A NCAC Subchapter 13A.0112	Provides numerical treatment standards for hazardous wastes or hazardous waste extracts before land disposal is allowed.
Classification and water quality standards applicable to surface water and wetlands in North Carolina	Title 15A NCAC Subchapter 2B.0100 and .0200	Establishes a series of numerical standards for surface water and wetland quality.
Effluent limitations	Title 15A NCAC Subchapter 2B.0400	Establishes basic permitting and wastewater treatment requirements for effluent discharge.

Table N-3 (Continued)
Action-Specific ARARs[(1)]
Former Chlorine Plant

STANDARD, REQUIREMENT, OR LIMITATION	CITATION	DESCRIPTION
State Action-Specific ARARs (Continued)		
Ambient air quality standard	Title 15A NCAC Subchapter 2D Section .0400	Establishes ambient air quality standards for sulfur dioxide, total suspended particulates, PM_{10}, carbon monoxide, ozone, nitrogen dioxide, etc.
Emission control standards	Title 15A NCAC Subchapter 2D Section 0.500	Establishes emission standards for seven contaminants - benzene, mercury, arsenic, asbestos, beryllium, vinyl chloride, and radionuclides.
Control of toxic air pollutants	Title 15A NCAC Subchapter 2D Section .1100	Establishes air toxic threshold concentrations.
Requirements for fugitive non-process dust emissions	Title 15A NCAC Subchapter 2D Section .0540	Establishes regulations for the release of fugitive dust from specific sources and activities.
Dredging	15A NCAC Chapter 4	Erosion and sediment control regulations.
	15A NCAC Chapter 2B	Surface water and wetland standards.
Requirements for wastewater discharge to surface water	Title 15A NCAC Subchapter 2H.0100	Establishes requirements for the discharge of effluent from point sources into surface waters. State-level version of Federal NPDES Program.
General provisions	Title 15 NCAC Subchapter 13B.0100	Establishes standards and regulations for generators of solid waste.
North Carolina Solid Waste Management Act	NCGS 130 A, Article 9	Requirements for solid waste generators, treaters, disposers, and managers.
Classification and water quality standards applicable to surface water and wetlands in North Carolina	Title 15A NCAC Subchapter 2B.0100 and .0200	Establishes a series of numerical standards for surface water and wetland quality.

Note:
(1) Potential action-specific ARARs will be refined throughout the FS and RD/RA process.

Table N-3 (Continued)
Action-Specific ARARs[(1)]
Former Chlorine Plant

STANDARD, REQUIREMENT, OR LIMITATION	CITATION	DESCRIPTION
Federal Action-Specific ARARs		
Identification and listing of hazardous waste	40 CFR 261 Subpart C	Provides numerical criteria to determine those solid wastes that are subject to regulations as hazardous wastes.
Requirements for hazardous waste generators	40 CFR 262	Establishes standards for generators of hazardous wastes.
Treatment standards	40 CFR 268 Subpart D	Provides numerical treatment standards for hazardous wastes or hazardous waste extracts before land disposal is allowed.
Point sources	40 CFR Part 400	Establishes pretreatment concentrations.
National Pollutant Discharge Elimination System	CWA Part 402	Requires permits for the discharge of pollutants from any point source waters of the United States.
National primary and secondary ambient air quality standard	40 CFR Part 50	Sets primary and secondary air standards at levels to protect public health and public welfare.
National emission standards for hazardous air pollutants	40 CFR Part 61	Establishes emission standards for seven contaminants - benzene, mercury, arsenic, asbestos, beryllium, vinyl chloride, and radionuclides.
Dredge or fill requirements (Section 404)	33 USC 1251 40 CFR 230, 231	In areas encompassing aquatic ecosystems, requires permits for discharge of dredged or fill material into navigable waters.
Rivers and Harbors Act of 1889	33 USC 403	Requires permit for structures or work in or affecting navigable waters.

Note:
(1) Potential action-specific ARARs will be refined throughout the FS and RD/RA process.

Table N-3 (Continued)
Action-Specific ARARs[1]
Former Chlorine Plant

STANDARD, REQUIREMENT, OR LIMITATION	CITATION	DESCRIPTION
Federal Action-Specific ARARs (Continued)		
Worker health and safety	29 CFR 1910.120	Training, personnel protection, medical monitoring and other health and safety requirements for employees engaged in hazardous waste site operations.
	29 CFR 1926	Standards for general construction.
Tank systems	40 CFR Part 264/265 Subpart J	Tank systems for the treatment or storage of hazardous wastes are to be designed and operated in a manner to prevent releases to the environment.
Wastewater discharge permits; effluent guidelines, Best Available Technology (BAT) and BMPPT	40 CFR Parts 122, 125, 401	Permit requirements for local point source discharges to waters of the United States; establishes effluent standards and requirements for preventing toxic releases.
National emission standards for hazardous air pollutants	40 CFR Part 63	Source-specific regulations that establish emission standards for hazardous air pollutants (HAPs).
New Source Performance Standard (NSPS)	40 CFR Part 6	Source-specific regulations with established testing, control, monitoring, and reporting requirements for new emission sources.

Note:
[1] Potential action-specific ARARs will be refined throughout the FS and RD/RA process.

Table N-3 (Continued)
Action-Specific ARARs[1]
Former Chlorine Plant

STANDARD, REQUIREMENT, OR LIMITATION	CITATION	DESCRIPTION
Federal Action-Specific ARARs (Continued)		
Phase IV Supplemental Proposal on Land Disposal of Mineral Processing Wastes	40 CFR Part 261 et al.	Supplemental Phase IV LDR rule (I) requires that the waste residual meet certain UTSs, (ii) prohibits storage except to facilitate treatment or disposal, (iii) prohibits the use of dilution to meet UTSs, and (iv) applies LDR paperwork requirements to the waste.
Requirements for management of hazardous contaminated media	40 CFR Part 260 et al.	Rule that addresses contaminated media that are currently subject to regulation as hazardous wastes under RCRA. Allows more flexible management standards for wastes generated during site cleanups. Modifies LDR treatment requirements and gives the USEPA and authorized states authority to remove certain wastes from regulation as hazardous waste under Subtitle C.
Off-site rule	40 CFR 330.440	Regulates the off-site management of wastes from the remediation of CERCLA sites.
U.S. Department of Transportation rules for hazardous materials transport	49 CFR Part 107 et seq.	Provides Hazardous Materials Program Procedures for transportation of hazardous materials.

Note:
(1) Potential action-specific ARARs will be refined throughout the FS and RD/RA process.

groundwater do not combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current and reasonable anticipated industrial land use, given exposure scenarios calculated in both the Human Health and the Ecological risk assessments. However, there is a significant possibility that, absent remedial action, a release of the large quantities of mercury present in on-site subsurface soils may occur, resulting in an unacceptable risk. The NCP establishes an expectation that EPA use treatment to address the principal threats posed by a site wherever practical (NCP §300.430(a)(1)(iii)(A)). The complex environmental setting and the limitations of *in-situ* treatment technologies for the mercury in soils and groundwater eliminated these treatment alternative. The majority of the source materials at the Former Chlorine Plant Area can be reliably contained in the long term.

6. Five-Year Reviews

The NCP §300.430 (f)(4)(ii) requires a five-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. This (these) reviews will be conducted every five-years, and will evaluate whether the remedy remains protective, or will be protective, of human health and the environment. Alternative 4 will result in hazardous substances, pollutants or contaminants remaining in place at the Former Chlorine Plant Area. Pursuant to CERCLA §121(c) and NCP §300.430 (f)(5)(iii)(C), a statutory five-year review is required five years from the beginning of on-site construction at the Former Chlorine Plant Area site.

O. Documentation of Significant Changes

The Proposed Plan for the Landfill No. 1 site was released for public comment on July 3, 2003. The Proposes Plan identified Alternative 4 as the preferred alternative for the site. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate. The Responsiveness Summary is contained in Appendix A, and the transcript of the Proposed Plan Public Meeting is contained in Appendix B.

APPENDIX B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
STATEMENT OF WORK FOR RD/RA
FORMER CHLORINE PLANT AREA

WEYERHAEUSER COMPANY PLYMOUTH WOOD TREATING PLANT SITE, NORTH CAROLINA

FINAL VERSION

APPENDIX B

STATEMENT OF WORK FOR THE FORMER CHLORINE PLANT AREA WEYERHAEUSER COMPANY PLYMOUTH WOOD TREATING PLANT SITE, NORTH CAROLINA

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STATEMENT OF WORK FOR THE FORMER CHLORINE PLANT AREA
WEYERHAEUSER COMPANY PLYMOUTH WOOD TREATING
PLANT SITE, NORTH CAROLINA

I. INTRODUCTION

This Statement of Work (SOW) outlines the work to be performed by Settling Defendant at the Former Chlorine Plant Area (OU-3) at the Weyerhaeuser Company Plymouth Wood Treating Plant site, Martin County, North Carolina ("the Site"). The work outlined is intended to implement the remedy as described in the Record of Decision (ROD) for OU-3, dated September 29, 2003, and to achieve the Performance Standards set forth in the ROD, Consent Decree and this SOW. The requirements of this SOW will be further detailed in work plans and other documents to be submitted by the Settling Defendant for approval as set forth in this SOW. It is not the intent of this document to provide task specific engineering or geological guidance. The definitions set forth in Section IV of the Consent Decree shall also apply to this SOW unless expressly provided otherwise herein.

Settling Defendant is responsible for performing the Work to implement the selected remedy. EPA shall conduct oversight of the Settling Defendant's activities throughout the performance of the Work. The Settling Defendant shall assist EPA in conducting oversight activities.

Except where otherwise provided, EPA review or approval of a task or deliverable shall not be construed as a guarantee as to the adequacy of such task or deliverable. If EPA modifies a deliverable pursuant to Section XI of the Consent Decree, such deliverable as modified shall be deemed approved by EPA for purposes of this SOW. A summary of the major deliverables that Settling Defendant shall submit for the Work is attached.

II. OVERVIEW OF THE REMEDY

THE OBJECTIVES OF THIS REMEDIAL ACTION ARE TO:

Maintain acceptable levels of potential risk to human receptors associated with exposure to mercury in soil and groundwater at the Former Chlorine Plant area;

Limit the migration of mercury from soil to groundwater and to the adjacent Roanoke River;

Reduce levels of mercury in groundwater at a point of compliance to a concentration of 1.1 ug/l in accordance with 15A NCAC 02L.0202(g)(91) or the alternative administrative provisions of the North Carolina groundwater 2L rules.

III. REMEDY COMPONENTS

The Remedy for OU3 includes containment of contaminated soils within the footprint of the Former Chlorine Plant using a barrier system, a surface cap containment system, shallow target area excavations, groundwater monitoring and institutional controls. The surface cap containment system will require the replacement of pavement over areas disturbed by the barrier wall installation and the excavation areas, and placement of pavement over surface soil adjacent to the river which lacks an impervious cover.

A. Components

The major components of the remedy are described in Section M, Selected Remedy section, of the attached Record of Decision.

B. Performance Standards

Settling Defendant shall meet all Performance Standards, as defined in the Consent Decree and refined in the Remedial Design, including clean-up levels and Remedial Action Objectives set forth in the attached Record of Decision, and in accordance with the Performance Standards Verification and Operation and Maintenance Plan.

C. Compliance Testing

Settling Defendant shall perform compliance testing to ensure that the Performance Standards are met. The soils and groundwater shall be tested in accordance with the Performance Standard Verification and Operation and Maintenance Plan, developed pursuant to Task IV of this SOW. If monitoring of the groundwater indicates that the Performance Standards as set forth in Section M of the Record of Decision, the Consent Decree, and the Performance Standards Verification Plan are not being achieved, EPA may reevaluate the effectiveness of the Former Chlorine Plant Area barrier as a source control remedy.

IV PLANNING AND DELIVERABLES

The specific scope of this work shall be documented by Settling Defendant in the Remedial Action (RA) Work Plan. Plans, specifications, submittals, and other deliverables shall be subject to EPA review and approval in accordance with Section XI of the Consent Decree.

Settling Defendant shall submit a technical memorandum documenting any need for additional data along with the proposed Data Quality Objectives (DQOs) whenever such requirements are identified. Settling Defendant is responsible for fulfilling additional data and analysis needs identified by EPA during the RD/RA process consistent with the general scope and objectives of the Consent Decree, including this SOW.

The major deliverables that are to be developed for this scope of work shall be submitted in draft form for USEPA review and comment. Final documents shall then be submitted for USEPA review and approval.

Settling Defendant shall perform the following tasks with respect to implementation of the remedy specified in the ROD for OU-3:

TASK I - COMMUNITY RELATIONS

The development and implementation of community relations activities are the responsibility of EPA. At the Remedial Design stage EPA is required to review the Community Relations Plan developed for the RI/FS, and to amend the plan as appropriate. Although implementation of the community relations plan is the responsibility of EPA, if requested by EPA, the Settling Defendant shall assist EPA by providing information regarding the history of OU-3 and participating in public meetings. In addition, upon request by EPA, the Settling Defendant shall prepare a plan (hereinafter referred to as the Technical Assistance Plan or TAP). The Tap shall be a joint TAP for both OU-3 and OU1 (the Former No. 1 Landfill) prepared, funded, and implemented in accordance with Paragraph 103 of the Consent Decree for RD/RA for OU1.

The extent of the Settling Defendant's involvement in community relations activities is left to the discretion of EPA. In addition to devising and administering the Technical Assistance Plan, all other community relations responsibilities EPA may assign to the Settling Defendant shall be specified in the community relations plan. All community relations activities conducted by Settling Defendant shall be subject to oversight by EPA.

TASK II - REMEDIAL DESIGN

The Remedial Design shall provide the technical details for implementation of the Remedial Action in accordance with currently accepted environmental protection technologies and standard professional engineering and construction practices.
The development of the detailed Remedial Design for the remedy outlined in the ROD, the Consent Decree and this SOW, will be initiated by the Settling Defendant within 30 days after receipt of notice of the authorization to proceed. The design shall include clear and comprehensive design plans and specifications. The ~~final~~ design will be submitted to EPA for review and approval as an attachment to the Remedial Action Work Plan described in Task III.

Any pre-design data collection activities associated with this SOW will be performed following plans developed and utilized during the Remedial Investigation/Feasibility Study activities conducted under Administrative Order by Consent (EPA Docket No: 98-10-C), and in particular, the approved Field Sampling and Analysis Plan, the approved Quality Assurance Project Plan, and the reviewed Health and Safety Plan. Settling

Defendant shall provide EPA with 10 days notice prior to performing field sampling activities.

TASK III - REMEDIAL ACTION

Remedial Action shall be performed by Settling Defendant to implement the response actions selected in the ROD. It is possible that the implementation of the schedule for this SOW will coincide with the remedial actions for OU1. Should such a situation arise, EPA will allow revision of the schedule for RA implementation to offset major construction activities associated with the implementation of the remedies for OU1 and OU3. The Preconstruction Conference for OU3 will be scheduled after the Prefinal Construction Inspection for OU1.

A. Remedial Action Planning

Within 30 days of receipt of the notice of the authorization to proceed, Settling Defendant shall commence submittal of monthly progress reports and continue such reports until the draft RA Work Plan has been submitted. The reporting schedule will then revert to the interval noted in the requirements for the project management plan. The monthly reports shall be consistent with the format noted in Section X of the Consent Decree.

Within 90 days of receipt of the notice of the authorization to proceed, Settling Defendants shall meet or participate in a conference call with EPA to discuss the current status of the RD/RA deliverables.

Within 180 days of receipt of the notice of the authorization to proceed, Settling Defendant shall submit a draft Remedial Action (RA) Work Plan (including the Remedial Design), a Project Delivery Strategy, a Construction Management Plan, a Construction Quality Assurance Plan, and a Construction Health and Safety Plan/Contingency Plan. The RA Work Plan (and associated Remedial Design), a Project Delivery Strategy, Construction Management Plan, and Construction Quality Assurance Plan must be reviewed and approved by EPA and the Construction Health and Safety Plan/Contingency Plan reviewed by EPA prior to the initiation of the Remedial Action.

Upon approval of the RA Work Plan, Settling Defendant shall implement the RA Work Plan in accordance with the construction management schedule. Significant field changes to the RA as set forth in the RA Work Plan shall not be undertaken without the approval of EPA. The RA shall be documented in enough detail to produce as-built construction drawings after the RA is complete. Deliverables shall be submitted to EPA for review and approval in accordance with Section XI of the Consent Decree. Review and/or approval of submittals does not imply acceptance of later submittals that have not been reviewed, nor that the remedy, when constructed, will meet Performance Standards.

1. RA Work Plan

A Work Plan which provides a detailed plan of action for completing the RA activities shall be submitted to EPA for review and approval. The objective of this work plan is to provide for the safe and efficient completion of the RA. The Work Plan shall be developed in conjunction with the Project Delivery Strategy, Construction Management Plan, the Construction Quality Assurance Plan, and the Construction Health and Safety Plan/Contingency Plan. These plans may be appended or delivered under separate cover. The Work Plan shall include a comprehensive description of the work to be performed and the Final Construction schedule for completion of each major activity and submission of each deliverable.

Specifically, the RA Work Plan shall present the following:

a. A statement of the problem(s) and potential problem(s) posed by OU-3 and the objectives of the RD/RA.

b. A background summary that references the approved RI, and FS reports and presents a synopsis of applicable information including:

1) A brief description of OU-3 including the geographic location and site features.

2) A brief synopsis of the history of OU-3 including past disposal practices and a description of previous work conducted.

c. A brief summary of the existing data including physical and chemical characteristics of the contaminants identified and including new information and data that is collected after initiation of the RD/RA activities, and their distribution in environmental media at OU-3.

d. A detailed description of the tasks to be performed and a description of the work products to be submitted to EPA. This includes the deliverables set forth in the remainder of Task III.

e. A schedule for completion of each required activity and submission of each deliverable required by the Consent Decree, including those in this SOW. This schedule shall also include information regarding timing, initiation and completion of all critical path milestones for each activity and/or deliverable including EPA document review and approval. The schedule shall incorporate the uncertain length of agency review activities by reflecting in the work plan schedule the trigger date for revisions as the date of receipt of agency comments plus a specified number of days to address comments.

f. A project management plan, including provision for quarterly reports (monthly reports during design and construction) to EPA. EPA's Project Coordinator and the Settling Defendant's Project Coordinator will meet, at a minimum, on a quarterly basis, unless EPA determines that such meeting is unnecessary. The data management plan shall address the requirements for project management systems, including tracking, sorting, and retrieving the data along with an identification of the software to be used, minimum data requirements, data format and backup data management. The plan shall address both data management and document control for all activities conducted during the RD/RA.

g. A description of the community relations support activities to be conducted during the RD/RA, consistent with the EPA prepared community relations plan. At EPA's request, Settling Defendant shall assist EPA in preparing and disseminating information to the public regarding the RD/RA work to be performed.

h. An attachment, which presents the remedial design, which shall include the following:

i. Results of Data Acquisition Activities

Data gathered during the design phase, if any, shall be compiled, summarized, and submitted along with an analysis of the impact of the results on design activities. Surveys conducted to establish topography, rights-of-way, easements, and utility lines shall be documented. Utility requirements and acquisition of access, through purchases or easements, that are necessary to implement the RA shall also be discussed.

ii. Plans and Specifications

A complete set of construction drawings and specifications for all components of the Remedial Action shall be prepared and submitted. All plans and specifications shall conform with the Construction Specifications Institute Master Format, and the scope of the technical specifications shall be outlined in a manner reflecting the final specifications. Design calculations shall be included. All Final Design documents shall be certified by a

Professional Engineer registered in the State of North Carolina. EPA written approval of the Final Design is required before initiating the RA, unless specifically authorized by EPA.

iii. Plan for Satisfying Permitting Requirements

All activities must be performed in accordance with the requirements of applicable federal and state laws and regulations. Any off-site disposal shall be in compliance with the requirements set forth in Paragraph 16 of the Consent Decree. The plan shall identify the off-site disposal/discharge permits that are required, the time required to process the permit applications, and a schedule for submittal of the permit applications.

iv. Construction Schedule

Settling Defendant shall develop and submit a Construction Schedule to EPA for approval. The Schedule will include the construction and implementation of the remedial action and will identify the timing for initiation and completion of all critical path tasks. Settling Defendant shall specifically identify dates for completion of the project and major milestones.

2. Project Delivery Strategy

Settling Defendant shall submit a document to EPA for review and approval describing the strategy for delivering the project. This document shall address the management approach for implementing the Remedial Action, including procurement methods and contracting strategy, phasing alternatives, and contractor and equipment availability concerns. If the construction of the remedy is to be accomplished by Settling Defendant's "in-house" resources, the document shall identify those resources.

3. Construction Management Plan

A Construction Management Plan shall be developed to indicate how the construction activities are to be implemented and coordinated with EPA during the RA. Settling Defendant shall designate a person to be a Remedial Action Coordinator and its representative on-site during the Remedial Action, and identify this person in the Plan. This Plan shall also identify other key project management personnel and lines of authority, and provide descriptions of the duties of the key personnel along with an organizational chart. In addition, a plan for the administration of construction changes and EPA review and approval of those changes shall be included.

4. Construction Quality Assurance Plan

Settling Defendant shall develop and implement a Construction Quality Assurance Program to ensure, with a reasonable degree of certainty, that the completed Remedial Action meets or exceeds all design criteria, plans and specifications, and Performance Standards. The Construction Quality Assurance Plan shall incorporate relevant provisions of the Performance Standards Verification Plan (see Task V). At a minimum, the Construction Quality Assurance Plan shall include the following elements:

a. A description of the quality control organization, including a chart showing lines of authority, identification of the members of the Independent Quality Assurance Team (IQAT), and acknowledgment that the IQAT will implement the control system for all aspects of the work specified and shall report to the project coordinator and EPA. The IQAT members shall be representatives from testing and inspection organizations and/or the Supervising Contractor and shall be responsible for the QA/QC of the Remedial Action. The members of the IQAT shall have a good professional and ethical reputation, previous experience in the type of QA/QC activities to be implemented, and demonstrated capability to perform the required activities. They shall also be independent of the construction contractor.

b. The name, qualifications, duties, authorities, and responsibilities of each person assigned a QC function.

c. Description of the observations and control testing that will be used to monitor the construction and/or installation of the components of the Remedial Action. This includes information which certifies that personnel and laboratories performing the tests are qualified and the equipment and procedures to be used comply with applicable standards. Any laboratories to be used shall be specified. Acceptance/Rejection criteria and plans for implementing corrective measures shall be addressed.

d. A schedule for managing submittals, testing, inspections, and any other QA function (including those of contractors, subcontractors, fabricators, suppliers, purchasing agents, etc.) that involve assuring quality workmanship, verifying compliance with the plans and specifications, or any other

QC objectives. Inspections shall verify compliance with all environmental requirements and include, but not be limited to, air quality particulate monitoring records and waste disposal records, etc.

e. Reporting procedures and reporting format for QA/QC activities including such items as daily summary reports, schedule of data submissions, inspection data sheets, problem identification and corrective measures reports, evaluation reports, acceptance reports, and final documentation.

f. A list of definable features of the work to be performed. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements.

5. Construction Health and Safety Plan/Contingency Plan

Settling Defendant shall prepare a Construction Health and Safety Plan/Contingency Plan in conformance with Settling Defendant's health and safety program, and in compliance with OSHA regulations. The Construction Health and Safety Plan shall include a health and safety risk analysis, a description of monitoring and personal protective equipment, medical monitoring, and site control. EPA will not approve Settling Defendant's Construction Health and Safety Plan/Contingency Plan, but rather EPA will review it to ensure that all necessary elements are included, and that the plan provides for the protection of human health and the environment. This plan shall include a Contingency Plan and incorporate Air Monitoring and Spill Control and Countermeasures Plans if determined by EPA to be applicable for OU-3. The Contingency Plan is to be written for the on-site construction workers and the local affected population. It shall include the following items:

a. Name of person who will be responsible for coordinating responses in the event of an emergency incident.

b. Plan for initial OU-3 construction safety indoctrination and training for all employees/contractors, etc., participating in the RA, name of the person who will give the training and the topics to be covered.

c. Plan and date for a pre-construction meeting or conference call (if requested by EPA) to brief the local community, including local, state and federal agencies involved in the cleanup, as well as the local emergency squads and the local hospitals, regarding the schedule and expected activities to be conducted on-site.

d. A list of the first aid and medical facilities including, location of first aid kits, names of personnel trained in first aid, a clearly marked map with the route to the nearest medical facility, all necessary emergency phone numbers conspicuously posted at the job site (i.e., fire, rescue, local hazardous material teams, National Emergency Response Team, etc.)

e. Plans for protection of public and visitors to the job site.

f. A Spill Control and Countermeasures Plan which, if determined to by EPA to be applicable, shall include the following:

1) Contingency measures for potential spills and discharges from materials handling and/or transportation.

2) A description of the methods, means, and facilities required to prevent contamination of soil, water, atmosphere, and uncontaminated structures, equipment, or material by spills or discharges.

3) A description of the equipment and personnel necessary to perform emergency measures required to contain any spillage and to remove spilled materials and soils or liquids that become contaminated due to spillage. This collected spill material must be properly disposed of.

4) A description of the equipment and personnel to perform decontamination measures that may be required for previously uncontaminated structures, equipment, or material.

B. <u>Preconstruction Conference</u>

A Preconstruction Conference shall be held after selection of the construction contractor but before initiation of construction. This conference shall include Settling Defendant, EPA and NCDENR and may include other appropriate federal, state and local government agencies. The conference shall:

1. Define the roles, relationships, and responsibilities of all parties;

2. Review methods for documenting and reporting inspection data;

3. Review methods for distributing and storing documents and reports;

4. Review work area security and safety protocols;

5. Review the Construction Schedule;

6. Conduct a site reconnaissance to verify that the design criteria and the plans specifications are understood and to review material and equipment storage locations.

The Preconstruction Conference must be documented, including names of people in attendance, issues discussed, clarifications made, special instructions issued, etc.

C. <u>Prefinal Construction Inspection</u>

Upon preliminary project completion Settling Defendant shall notify EPA for the purpose of conducting a Prefinal Construction Inspection. Participants should include the Project Coordinators, Supervising Contractor, Construction Contractor, Natural Resource Trustees and other federal, state, and local agencies with a jurisdictional interest. The Prefinal Inspection shall consist of a walk-through inspection of the OU-3 project site. The objective of the inspection is to determine whether the construction is complete and consistent with the Consent Decree. Any outstanding construction items discovered during the inspection shall be identified and noted on a punch list. Additionally, treatment equipment shall be operationally tested by Settling Defendant. Settling Defendant shall certify that the equipment has performed to effectively meet the purpose and intent of the specifications. Retesting shall be completed where deficiencies are revealed. A Prefinal Construction Inspection Report shall be submitted by Settling Defendant which outlines the outstanding construction items, actions required to resolve the items, completion date for the items, and an anticipated date for the Final Inspection.

D. <u>Final Construction Inspection</u> (if requested by EPA)

Upon completion of all outstanding construction items, Settling Defendant shall submit an amended Prefinal Construction Inspection Report with a new section to document the response actions taken to resolve outstanding construction items identified during the Prefinal Construction Inspection. If EPA determines that the outstanding construction items are resolved, EPA shall approve the amended

Prefinal Construction Inspection Report in lieu of performing a Final Construction Inspection.

If EPA determines that a Final Construction Inspection is appropriate, EPA shall notify the Settling Defendant for the purpose of conducting a Final Construction Inspection. The Final Construction Inspection shall consist of a walk-through inspection of the OU-3 project site. The Prefinal Construction Inspection Report shall be used as a check list with the Final Construction Inspection focusing on the outstanding construction items identified in the Prefinal Construction Inspection. All tests that were originally unsatisfactory shall be conducted again. Confirmation shall be made during the Final Construction Inspection that all outstanding items have been resolved. Any outstanding construction items discovered during the inspection still requiring correction shall be identified and noted on a punch list. If any items are still unresolved, the inspection shall be considered to be a Prefinal Construction Inspection requiring another Prefinal Construction Inspection Report and subsequent Final Construction Inspection.

E. Interim Remedial Action Report

Within sixty (60) days following the (i) conclusion of the Final Construction Inspection or (ii) date upon which Settling Defendant receives notice that the Prefinal Construction Inspection Report is approved, and that a Final Construction Inspection will not be required, Settling Defendant shall submit an Interim Remedial Action (RA) Report. EPA will review the draft report and will provide comments to Settling Defendant. The Interim RA Report shall be generally consistent with EPA guidance for preparing the report (*Close Out Procedures for National Priorities List Sites,* EPA, OSWER Directive 9320.2-09A-P) and include the following:

1. Introduction, providing a brief history and description of the site

2. Operable Unit Background

3. Construction Activities

4. Chronology of Events, including a projection of when clean-up levels for the groundwater will be achieved

5. Performance Standards and Construction Quality Control

6. Final Inspection and Certifications

7. Operation and Maintenance Activities

After EPA review, Settling Defendant shall address any comments and submit a revised report. The Remedial Action shall be complete when EPA approves the Interim RA Report. However, the long term remedial action will not be considered complete until all cleanup goals have been achieved. Further details can be found in the following Section F.

F. <u>Final Remedial Action Report</u>

Within thirty days (30) days following the receipt of sampling data documenting the achievement of all cleanup goals specified in the ROD, the Settling Defendant shall submit a Final Remedial Action (RA) Report. EPA will review the draft report and will provide comments to Settling Defendant. The Final RA Report shall be consistent with EPA guidance for preparing the report (*Close Out Procedures for National Priorities List Sites,* EPA, OSWER Directive 9320.2-09A-P). When an interim RA report has already been prepared, the interim RA report can be simply amended to create the final RA report. The amendment would add information on activities that occurred after the interim RA report was completed.

<u>TASK IV - PERFORMANCE STANDARDS VERIFICATION AND OPERATION AND MAINTENANCE</u>

Settling Defendant shall submit a Performance Standard Verification and Operation and Maintenance Plan (PSV/OM Plan) 30 days after EPA approval of the RA workplan. The PSV/OM Plan must be reviewed and approved by EPA prior to initiation of Operation and Maintenance activities. If necessary, the PSV/OM Plan shall be modified to incorporate any design modifications implemented during the Remedial Action. Performance Standard Verification and Operation and Maintenance shall be performed in accordance with the approved PSV/OM Plan.

Upon approval of the PSV/OM Plan, Settling Defendant shall implement the PSV/OM Plan in accordance with the schedule contained therein. This plan shall describe start-up procedures, operation, troubleshooting, training, and evaluation activities that shall be carried out by Settling Defendant. The plan shall address the following components:

A. <u>Operation and Maintenance Plan</u>

1. Description of normal operation and maintenance;

    a. Description of tasks required for barrier and cap system maintenance;

b. Schedule showing the required frequency for each O&M task.

2. Description of potential operating problems;

   a. Description and analysis of potential maintenance problems;

   b. Sources of information regarding problems; and

   c. Common remedies or anticipated corrective actions.

3. Safety Plan;

   a. Description of precautions to be taken and required health and safety equipment, etc., for site personnel protection.

4. Description of equipment;

   a. Equipment identification;

   b. Installation of monitoring components;

   c. Maintenance of site equipment; and

   d. Replacement schedule for equipment and installation components.

5. Records and reporting;

   a. Laboratory records;

   b. Records of operating cost;

   c. Mechanism for reporting emergencies;

   d. Personnel and Maintenance Records; and

   e. Quarterly reports to State/Federal Agencies.

6. Description of monitoring and laboratory testing;

   a. Description of monitoring tasks, (including performance standards verification as described in the following section)

b. Description of required laboratory tests and their interpretation;

c. Required QA/QC; and

d. Schedule of monitoring frequency and date, if appropriate, when monitoring may cease.

B. <u>Performance Standards Verification Component of the Plan</u>

Performance monitoring shall be conducted to ensure that both short-term and long-term Performance Standards for the Remedial Action are met. Guidances used in developing the Sampling and Analysis Plans during prior RI/FS or RD activities at the Site shall be used. Once approved, Settling Defendant shall implement the Performance Standards Verification monitoring on the approved schedule. The Performance Standards Verification Component of the Plan shall include:

1. Direction for all fieldwork by defining in detail the sampling and data gathering methods to be used. It shall include sampling objectives, sample location (horizontal and vertical) and frequency, sampling equipment and procedures, and sample handling and analysis. The information shall be written so that a field sampling team unfamiliar with OU-3 would be able to gather the samples and field information required.

2. Description of the quality assurance and quality control protocols which will be followed in demonstrating compliance with Performance Standards. Quality assurance and quality control (QA/QC) protocols that shall be used to achieve the desired DQOs. The DQOs shall, at a minimum, reflect use of analytical methods for obtaining data of sufficient quality to meet National Contingency Plan requirements as identified at 300.435 (b). In addition, the QAPP shall address personnel qualifications, sampling procedures, sample custody, analytical procedures, and data reduction, validation, and reporting. These procedures must be consistent with the Region IV Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual and with the guidances specified in Section VIII of the Consent Decree. If a laboratory has not been previously approved for use on the Site, Settling Defendant shall demonstrate in advance and to EPA's satisfaction that the laboratory is qualified to conduct the proposed work and meets the requirements specified in Section VIII of the Consent Decree. EPA may require that

Settling Defendant submit detailed information to demonstrate that the laboratory is qualified to conduct the work, including information on personnel qualifications, equipment and material specification, and laboratory analyses of performance samples (blank and/or spike samples). In addition, EPA may require submittal of data packages equivalent to those generated by the EPA Contract Laboratory Program (CLP). If a selected laboratory is not currently participating in the CLP, methods consistent with CLP methods that would be used at this site for the purposes proposed and QA/QC procedures approved by EPA, shall be used.

3. Specification of those tasks to be performed by Settling Defendant to demonstrate compliance with the Performance Standards and a schedule for the performance of these tasks.

REFERENCES

The following list, although not comprehensive, comprises many of the regulations and guidance documents that apply to the RD/RA process. Settling Defendant shall review these guidances and shall use the information provided therein in performing the RD/RA and preparing all deliverables under this SOW.

1. "National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule", Federal Register 40 CFR Part 300, March 8, 1990.

2. "Remedial Design/Remedial Action Handbook," U.S. EPA, Office of Emergency and Remedial Response, June 1995, OSWER Directive No. 9355.O-4B.

3. "Interim Final Guidance on Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties," U.S. EPA, Office of Emergency and Remedial Response, February 14, 1990, OSWER Directive No. 9355.5-01.

4. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final," U.S. EPA, Office of Emergency and Remedial Response, October 1988, OSWER Directive No. 355.3-01.

5. "Interim Final Guidance on Data Quality Objectives Process for Superfund," U.S. EPA, Office of Solid Waste and Emergency Response, EPA/540/G-93/071, September 1993, OSWER Directive No. 9335.9-01.

6. "Guidelines and Specifications for Preparing Quality Assurance Project Plans," U.S. EPA, Office of Research and Development, Cincinnati, OH, QAMS-004/80, December 29, 1980.

7. "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," U.S. EPA, Office of Emergency and Remedial Response, QAMS-005/80, December 1980.

8. "Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual," U.S. EPA Region IV, Environmental Services Division, February 1, 1991, (revised periodically).

9. "USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis," U.S. EPA, Office of Emergency and Remedial Response, July 1988.

10. "Quality in the Constructed Project: A Guideline for Owners, Designers, and Constructors, Volume 1, Preliminary Edition for Trial Use and Comment," American Society of Civil Engineers, May 1988.

11. "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements," U.S. EPA, Office of Emergency and Remedial Response, July 9, 1987, OSWER Directive No. 9234.0-05.

12. "CERCLA Compliance with Other Laws Manual," Two Volumes, U.S. EPA, Office of Emergency and Remedial Response, August 1988 (Draft), OSWER Directive No. 9234.1-01 and -02.

13. "Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites," U.S. EPA, Office of Emergency and Remedial Response, (Draft), OSWER Directive No. 9283.1-2.

14. "Guide for Conducting Treatability Studies Under CERCLA," U.S. EPA, Office of Emergency and Remedial Response, Pre-publication Version.

15. "Health and Safety Requirements of Employees Employed in Field Activities," U.S. EPA, Office of Emergency and Remedial Response, July 12, 1981, EPA Order No. 1440.2.

16. "Standard Operating Safety Guides," U.S. EPA, Office of Emergency and Remedial Response, November 1984.

17. "Standards for General Industry," 29 CFR Part 1910, Occupational Health and Safety Administration.

18. "Standards for the Construction Industry," 29 CFR 1926, Occupational Health and Safety Administration.

19. "NIOSH Manual of Analytical Methods," 2d edition. Volumes I - VII, or the 3rd edition, Volumes I and II, National Institute of Occupational Safety and Health.

20. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," National Institute of Occupational Safety and Health/Occupational Health and Safety Administration/United States Coast Guard/ Environmental Protection Agency, October 1985.

21. "TLVs - Threshold Limit Values and Biological Exposure Indices for 1987 - 88," American Conference of Governmental Industrial Hygienists.

22. "American National Standards Practices for Respiratory Protection," American National Standards Institute Z88.2-1980, March 11, 1981.

SUMMARY OF THE MAJOR DELIVERABLES FOR THE
REMEDIAL DESIGN AND REMEDIAL ACTION AT
FORMER CHLORINE PLANT AREA
WEYERHAEUSER COMPANY PLYMOUTH WOOD TREATING
PLANT SITE, NORTH CAROLINA

DELIVERABLE	EPA RESPONSE
TASK I — COMMUNITY RELATIONS	
Technical Assistance Plan (if necessary)	Review and Approve
TASK II — REMEDIAL DESIGN	
TASK III — REMEDIAL ACTION	
RA Work Plan (4)	Review and Approve
Remedial Design (4), including:	Review and Approve
Results of Data Acquisition Activities	Review and Approve
Plan for Satisfying Permitting Requirements	Review and Approve
Plans and Specifications	Review and Approve
Construction Schedule	Review and Approve
Complete Design Analyses	Review and Approve
Project Delivery Strategy (4)	Review and Approve
Construction Management Plan (4)	Review and Approve
Construction Quality Assurance Plan (4)	Review and Approve
Construction Health and Safety Plan/Contingency Plan (4)	Review and Comment
Prefinal Construction	Review and Approve

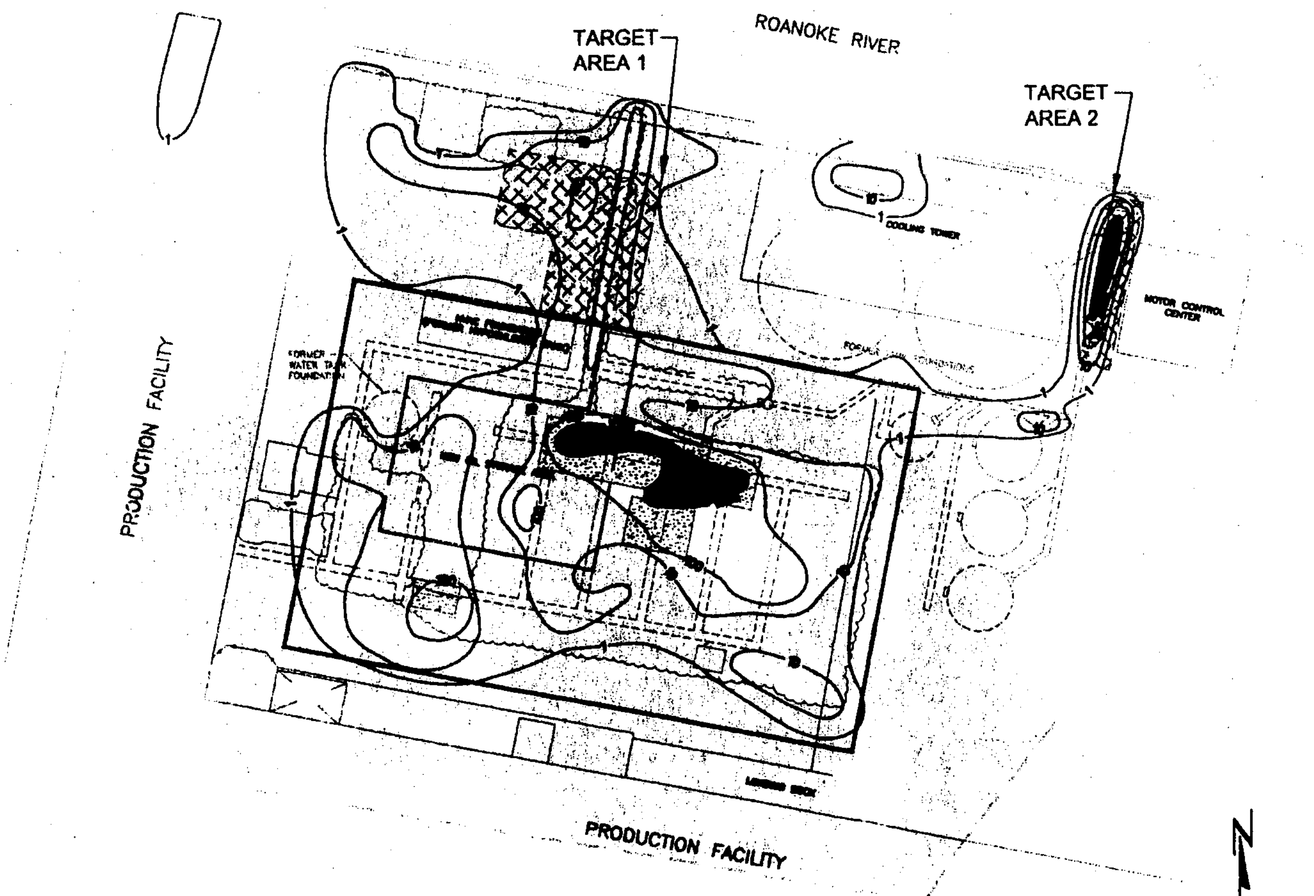
Inspection Report (4)	
Interim RA Report (5)	Review and Approve
Final RA Report (5)	Review and Approve

TASK IV PERFORMANCE STANDARD VERIFICATION AND OPERATION AND MAINTENANCE

Performance Standard Verification and Operation and Maintenance Plan (4)	Review and Approve

* NOTE: The number in parenthesis indicates the number of copies to be submitted by Settling Defendant. Additional copies to be provided if requested by EPA.

APPENDIX C
MAP OF OPERABLE UNIT 3
WEYERHAEUSER SITE, PLYMOUTH, NC



LEGEND

- APPROXIMATE LOCATION OF FORMER EQUIPMENT AND SUBSURFACE UTILITIES
- EXISTING EQUIPMENT
- APPROXIMATE EXTENT OF 4-FOOT DEEP SOIL EXCAVATION (HLA, 1992)
- BURIED CONCRETE SLABS
- — 10 — ESTIMATED EXTENT OF TOTAL MERCURY, ISOCONCENTRATION IN SOIL (mg/kg)
- PROPOSED TARGET AREA EXCAVATION LIMITS
- APPROXIMATE EXTENT OF DISSOLVED MERCURY ≥ 1 μg/L IN GROUNDWATER
- FENCE LINE
- PROPOSED BARRIER WALL ALIGNMENT

LEGEND (CONT.)

- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥1000mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥100mg/kg
- TOTAL MERCURY CONCENTRATIONS IN SOIL ≥10mg/kg

0 40' 80'
SCALE: 1"=40'

NOTES

1. BASE MAP PRODUCED BY PHOTOGRAMMETRIC DATA SERVICES, INC.
2. ESTIMATED MERCURY ISOCONCENTRATIONS IN SUBSURFACE SOIL DETERMINED FROM FIGURE 5-1A OF THE REMEDIAL INVESTIGATION REPORT (RMT 2000).
3. SUBSURFACE SOIL MERCURY CONCENTRATIONS PRESENTED FOR 8 TO 0 FT. NGVD29. (0-8 FT BGS)
4. GROUND SURFACE ELEVATION APPROXIMATELY 8 FEET NGVD29.

PROJECT: FEASIBILITY STUDY WEYERHAEUSER CO. MARTIN COUNTY, NORTH CAROLINA		
SHEET TITLE: ALTERNATIVE 4 - CONTAINMENT WITH GROUNDWATER COMPLIANCE AND TREND MONITORING		
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 05100.63
CHECKED BY: BSJ	1"=40'	FILE NO. 51006302.DWG
APPROVED BY: SAM	DATE PRINTED:	
DATE: JUNE 2003	JUN 24 2003	Figure J-2

RMT inc.

51

PLOT DATA
Drawing Name: J5100\63\border.dwg
Operator Name: defoej
Scale: 1"=1'
Dwg Size: 44617 Bytes

Plot Date: Thursday, May 29,
Plot Time: 11:04:42 AM
Attached Xref's: No xref's attached.
Attached Image's: No images attached